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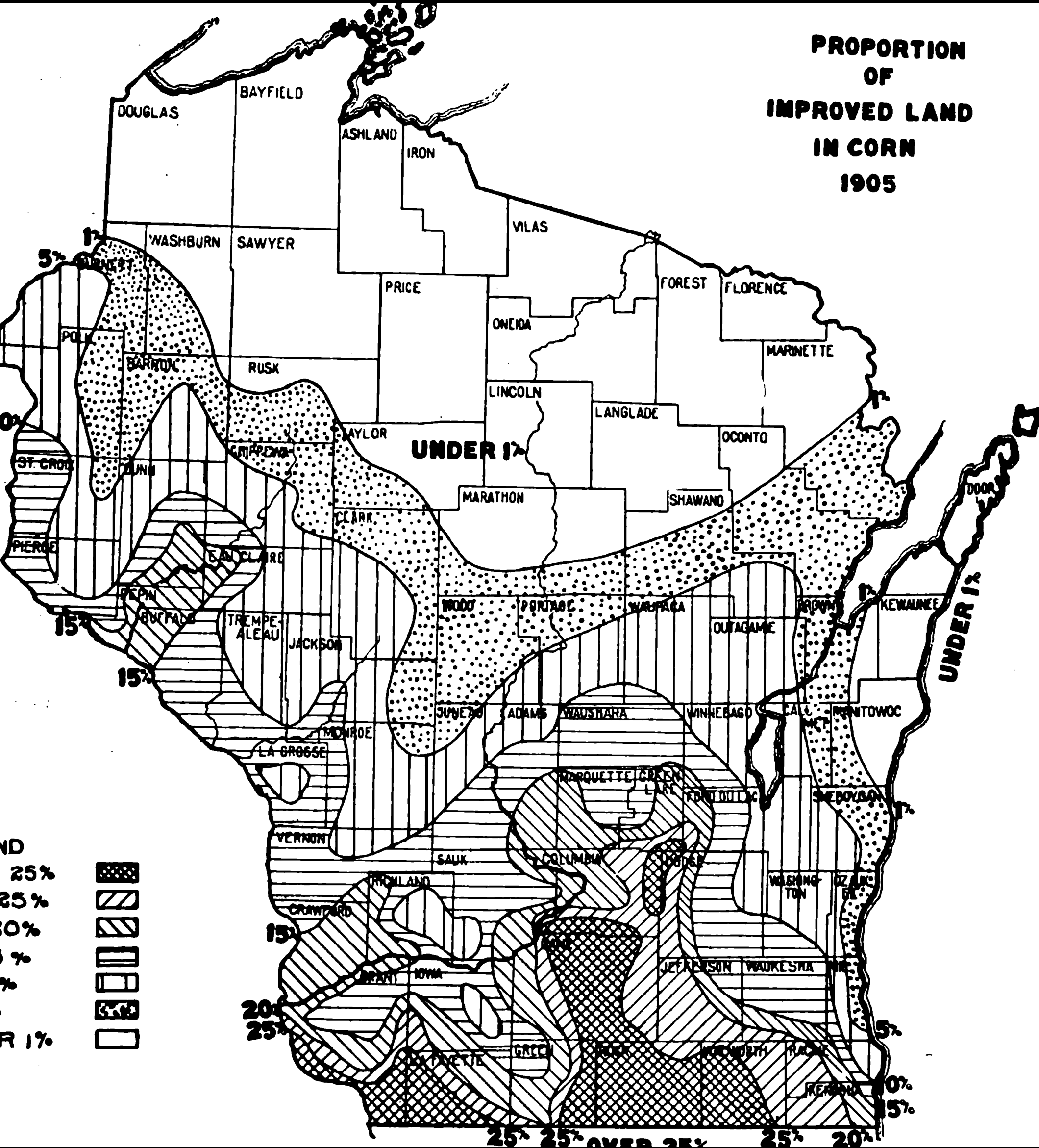

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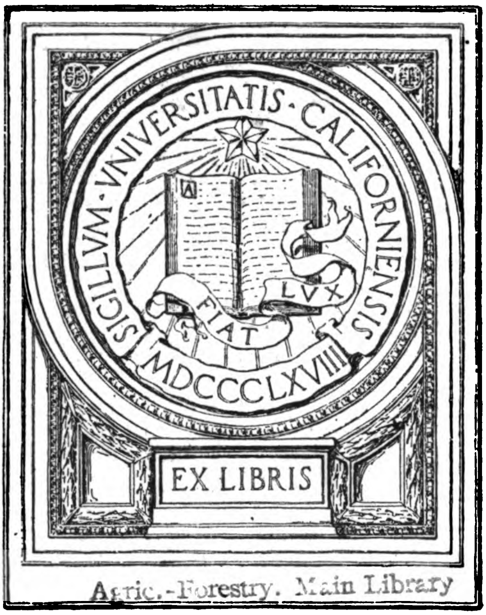

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THE UNIVERSITY OF WISCONSIN
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RELIEF MAP OF WISCONSIN

THE CLIMATE OF WISCONSIN AND ITS RELATION TO AGRICULTURE

BY

A. R. WHITSON AND O. E. BAKER

MADISON, WISCONSIN

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UNIV. OF CALIFORNIA

THE CLIMATE OF WISCONSIN AND ITS RELATION TO AGRICULTURE

A. R. WHITSON and O. E. BAKER

Among the factors which influence the agriculture of a state, none is more important than climate. The class of crops which can be grown is largely determined by the length of the growing season. This factor limits the area within which corn, cotton, or other important staple crops may be produced. The amount and especially the distribution of rainfall has a tremendous influence on the yield of all crops. In more than half of the United States the possibilities of agriculture are dependent almost solely on the amount of rainfall; and not only the total rainfall, but also its distribution has important influences on these crops. The grain crops will do well where there is a comparatively light rainfall if it is well distributed in the early spring and summer months. Corn, potatoes, and cotton require a heavier rainfall extending through the summer and early autumn months, while for the best pasturage, a more uniform distribution throughout the growing season is essential.

Other climatic factors such as humidity of the atmosphere and extremes in temperature have important influences, especially on the distribution of fruit and other trees. The production of tree fruits is largely determined by the late spring frosts, and the growth of many forest trees is influenced by the humidity of the atmosphere. This is distinctly seen in the distribution of the native vegetation of such states as Minnesota, Wisconsin, and Michigan, in which the sections bordering the lakes were originally covered by heavy forest growth. Striking influences of this character are seen in the growth of certain trees, for instance the beech, which grows only near

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lake shores where the humidity is relatively high and where extremes of temperature are prevented by the water.

In addition to these direct influences, the climate has a profound indirect influence on the crops through its effect on the soil. Fertility is largely the result of chemical decomposition of soil particles with the formation of soluble plant food from the insoluble compounds in the soil. If the rainfall is excessive and the soil porous, leaching of these soluble compounds takes place to such an extent that only a very low grade of fertility is possible. On the other hand, if precipitation is very light, most of the salts formed by this decomposition accumulate in the surface soil, and excessive development of these salts produces the alkali soils which, as is well known, are unfavorable to agriculture. These are some of the more important ways in which climate and weather affect agriculture.

The purpose of this bulletin is primarily to describe the climate and weather of Wisconsin, but in order to understand the climate of our own state it will be necessary to consider first some of the general principles of climate as they express themselves over the country as a whole. For this reason, the bulletin is divided into three parts, the first of which discusses the general principles of climate, and the second the special conditions of climate and weather existing in Wisconsin, while a final section considers briefly the relation of climate to the agriculture of the state.

The statements of climatic conditions made in this bulletin are based chiefly upon the records of the eighty odd stations of the United States Weather Bureau, whose location is shown in Figure 1.

PART I. CLIMATE IN GENERAL

The climate of a region is dependent mainly upon four factors:

1. Latitude, or distance north or south of the equator.
2. Distance and direction from large bodies of water.
3. Altitude, or elevation above sea level.
4. Weather, or the changes in temperature, rainfall, sunshine, etc., which occur from day to day.

In addition to these principal factors, the climate is influenced slightly by several secondary factors, such as character of the soil, chiefly with reference to drainage conditions, the nature of the vegetation, and local topography.

TEMPERATURE

The temperature of a locality is influenced by all four of the factors mentioned. The average decrease in mean (or average) annual temperature near the center of large continents at the latitude of Wisconsin is about 3° for each 100 miles as one travels northward. The northern boundary of Wisconsin, therefore, excluding all influences except latitude, should be about 9° cooler on the average than the southern boundary. The actual difference, however, is not so great on account of the modifying influence of Lakes Superior and Michigan.

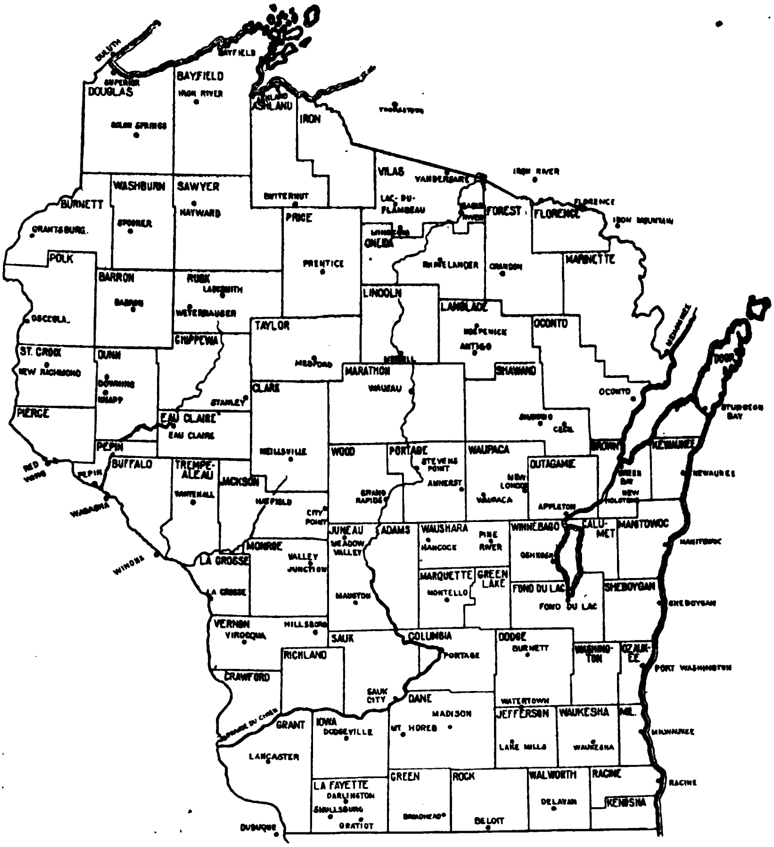

FIGURE 1. STATIONS OF UNITED STATES WEATHER BUREAU

This equalizing influence of water is one of the most important factors in climate, making the summers cooler and the winters warmer. This is due chiefly to the large heat-absorbing capacity of water, which is double that of land; and also to the fact that fully half the sun's heat that falls upon a water surface is lost in producing evaporation. This evaporation, in turn, develops a blanket of moist air less subject to marked temperature fluctuations.

Moreover, the sun's rays penetrate the water deeply, influencing its temperature thirty feet or more deep during a single day, while the temperature of the soil is influenced less than that many inches. The seasonal differences in temperature extend 500 feet deep in the water, but less than one-fifth of this in the soil. The result of these differences is that the heat is stored in the water during the summer to a much larger extent than in the soil, and this heat in turn is given up during the winter, raising the temperature of the air surrounding it. This influence of water is, of course, much more marked on ocean shores than on the shores of smaller inland bodies of water, yet the Great Lakes are of sufficient size to have a very important effect.

Altitude also has a profound influence on temperature. Indeed, the differences in temperature due to elevation are by far the most marked, averaging 1° for every 300 feet of elevation. The combined effect of latitude and altitude is seen very clearly in the height of the permanent snow line above sea level. This line leaves the sea level near the North Pole and reaches an altitude of about 10,000 feet at the latitude of 40° and of 16,000 to 18,000 feet at the equator. A difference of a few hundred feet in altitude frequently produces as great a change in temperature as does a difference of several hundred miles of latitude.

While the central states, including Wisconsin, have relatively little variation in altitude, still it is sufficient to produce differences which are important in their influence upon agriculture. Wisconsin may be described as a swell of land between three notable depressions, Lake Michigan on the east, Lake Superior on the north, and the Mississippi valley on the west. The T-shaped watershed averages in elevation about 1,100 feet in Lafayette and Iowa counties at the foot of the T, with an interruption where the Wisconsin River breaks through, then resumes this elevation in Richland and Monroe counties, widening out into a low plateau in Jackson, Clark, and Taylor counties, and finally joining the northern cross ridge in Price county. The northern water-shed gradually increases in elevation from 1,200 feet along the headwaters of the St. Croix, about 25 miles south of Lake Superior in the northwestern corner of the state, to 1,800 feet where the Iron ranges cross the Michigan boundary in Iron county.

The influence of these differences in elevation on the temperature may be seen by comparing the mean annual temperature of stations on the same latitude but differing in altitude. For instance, Beloit at an elevation of 750 feet has an average mean annual temperature of 47.3°, while Shullsburg with an elevation of 1,019 feet, has a temperature of 46.2°. Prairie du Chien at an elevation of 690 feet has an average annual temperature of 47.5°, while Mt. Horeb at 1226 feet has an average annual temperature of 45.1°. La Crosse at 714 feet has an average temperature of 46.1°, while Hillsboro at 1,000 feet has a temperature of 43.6°. The lake influence may counteract the effect of latitude and altitude or these three factors may all tend in the same direction. In this way, the state may be subdivided into climatic provinces which will be descrbed later.

The fourth factor mentioned as influencing temperature, that of weather, is primarily caused by what meteorologists term cyclonic storms. These cyclonic storms are not the small destructive whirlwinds, commonly so-called, which are correctly known as tornadoes, but are vast atmospheric disturbances many hundred miles across. They have a profound effect on both temperature and precipitation, and will be discussed after the influences of latitude, relation to water, and altitude upon precipitation have been mentioned.

PRECIPITATION

Precipitation of moisture, either in the form of rain or snow, is always the result of the cooling of the atmosphere. Moisture exists in the atmosphere in the form of gaseous water vapor, and the amount of water which can exist in this gaseous condition depends chiefly upon the temperature. Air at a temperature of 60° has a capacity for water vapor three times as great as at 0°, while at 100°, the capacity is fifteen times as great as at 0°. As a result, when the temperature of any mass of air is cooled, the ability for water to exist in the gaseous form is greatly reduced, and if the temperature goes below the point at which the moiture can remain in a gaseous form, condensation takes place and precipitation in some form begins. The ratio of the amount of water vapor actually in the atmosphere at any time to the amount which can exist in the air at that temperature, is known as its *relative humidity.*

On account of this profound influence of temperature on the moisture capacity of the atmosphere, the distribution of precipitation is markedly affected by all those factors which influence temperature as above noted. As a consequence, precipitation is relatively greater near the equator and in a general way decreases toward the poles. It is also influenced by altitude, the rainfall being greatest where higher elevations of land compel the air to rise and be chilled by expansion and by direct contact with the colder soil.

An excellent illustration of this influence is seen in the Sierra Nevada Mountains of our own Pacific States, which receive a heavy rainfall on their western slopes, increasing in the first 6000 feet on the average 1 inch for every 75 feet of rise, while the country lying east and in the lee of the mountains is largely of a desert nature, to the prairie states, which secure much of their moisture from the Gulf of Mexico and the Caribbean Sea. The absence of any such mountainous barrier allows a liberal and fairly uniform precipitation over northwestern Europe. While long observations of rainfall in different parts of Wisconsin are insufficient to determine the matter positively, still they seem to indicate somewhat greater rainfall on the higher regions of the north-central and southwestern portions of the state.

WEATHER

Weather is the term generally used to designate those changes in temperature, precipitation, sunshine, cloudiness, and humidity which occur at short intervals, that is, from day to day.

Those whose occupation gives them opportunity to be in the open much of the time, and especially farmers who are not only out of doors much of the time, but whose work is influenced by these changes, recognize the fact that there is a more or less definite succession of weather conditions from day to day. These changes do not always take place in the same order. It frequently happens, especially in the summer, that if the wind has been from one to several days in a southwesterly direction, long streaming clouds are noticed in a westerly or southerly direction, the temperature gets much warmer and either of two general types of change occur within the next two or three days. First, the wind shifts gradually to a southerly and southeasterly direction, cloudiness increases and precipitation commences, which may be light, or turn into a continuous rain for one to three days, with the wind shifting gradually to an easterly direction and finally around to the northwest, when precipitation stops, the sky becomes clear, and the temperature gets much cooler. Or, second, the wind may change around to the south and then gradually back to the southwest or west, during which time short thunder storms and showers occur, followed by clear and warm weather. A careful study of this whole matter by meteorologists has shown that these weather changes are associated with changes of barometric pressure, and that all these related events are part of a general storm movement, to which the name "cyclone" has been given by scientists.

These cyclonic storms, then, which constitute the primary cause of our weather changes, are found to be characterized by the development of an area of low barometric pressure somewhere in the west. This low-pressure area becomes the center toward which winds from all directions move, to be sucked in at the center, rise as an enormous column, and spread out in the upper atmosphere, where they flow outward as a great counter system of currents. These winds, however, do not move directly toward the low barometric center, but somewhat spirally in a counter clock-wise direction. Since more moisture can exist in warm than in cold air, those masses of air which come in from the south and are therefore warm, contain more moisture than can be retained after they have cooled on coming north and have risen in the ascending currents; hence the result is cloudiness, usually followed by precipitation. On account of the spiral motion above mentioned, it very commonly happens that the southerly winds move around to the east or northeast of the low area before being cooled enough to cause precipitation, and as a general rule, the areas of continuous rain or snow are east or northeast of the low area. However, the region southeast of the low barometric center is the area within which showers, thunder storms, or tornados (the so-called cyclones) occur. The colder winds of the north coming down toward the low area become capable of containing more moisture as they gradually become warmer in this southward movement, hence whatever clouds they may have carried are vaporized and the atmosphere becomes clear. As a consequence, the northwest or west winds following the low center of the cyclonic storm are clear and cold compared to those which preceded the storm center.

While it is true that there is considerable variation in the development of these storms in rate of movement of the storm center and in extent of area influenced, still it is true that a knowledge of this general character of the cyclonic storm enables one to predict with considerable certainty the character of the weather for the next twenty-four to thirty-six hours, and it is this basis which the officials of the Weather Bureau use as a foundation for their weather predictions.

These storm centers more frequently come from the northwest toward the Mississippi Valley, though occasionally from the west or even slightly southwest, and then move across the country northeastward, by far the greater majority of them leaving the country through the New England states. Their rate of movement, however, is variable, occupying from four tc eight days in crossing the country.

Not only do these cyclonic storms cause the frequent changes of the temperature and precipitation which we call weather, but their distribution frequently determines whether one section of the country will have a wet or a dry season. When a succession of these storm centers moves in a well defined path, the region north of the path of the center will have an unusually heavy rainfall during the season, while the region south of the path will have an unusually light rainfall. This tendency of the storm centers to move in well defined paths develops only at irregular times, but is probably the chief cause of the periods of wet weather and of drought, to which the whole interior of this country is more or less subject.

In addition to the influence of these cyclonic storms on precipitation and on the general temperature, the effect on formation of frosts is very pronounced. It is generally recognized that the occurrence of late spring and early fall frosts is the chief factor which limits the growing period for many crops, among them corn and potatoes. This occurrence of frost at some time after the general period of freezing has ended in spring and before it comes again in fall is practically always associated with the conditions of a cyclonic storm. The coming down of cold air from the north and northwest, following a storm, has the effect of chilling the ground by evaporation of the moisture which has preceded it. But in addition to this, the clear, dry atmosphere affords the best possible condition for the rapid loss of heat from the soil and lower layers of the atmosphere by radiation, and it is this rapid radiation through the clear atmosphere on still nights following a cyclonic storm which is the chief cause of these occasional frosts.

In the formation of early frosts the process is as follows: first, the surface soil loses it heat by direct radiation through the atmosphere just as the heat of a stove is radiated through the air of a room, then the air lying in immediate contact with the soil loses some of its heat to the soil by conduction, thereby becoming colder than the air at a little distance above. It is a matter of easy observation to show that the temperature of the air in the first one to four feet above the ground is colder than that five or six feet above the ground on such nights, and also that the surface half inch of soil itself is colder than the air above it.

As a result of this cooling of the lower layer of the atmosphere, it becomes denser and heavier and will flow down a slope, where such exists, and collect in hollows. This process is known as air drainage. As the colder surface air, which has been cooled by conduction to the colder soil, flows down the slope, the warmer upper atmosphere is drawn down to the soil, while the hollows are gradually filled with the colder and denser air. Consequently, frosts occur much more commonly on low areas and especially in hollows or pockets than on the higher slopes. An understanding of this principle is of prime importance in the selection of land for the location of crops sensitive to frosts.

Since the cooling of the lower layer of air is the result of the more rapid cooling of the surface soil, anything which affects the rate of cooling of the surface of the ground will affect the formation of frost. If the soil is bare and saturated with water, heat may be conducted to the surface from below rapidly enough to prevent the bare surface from reaching a freezing temperature. On the other hand, if there is a covering of grass or moss which acts as a non-conductor of heat, the upper portion of this grass layer will lose heat by radiation more rapidly than it can be gained by conduction from below, with the result that a freezing temperature may be reached. The difference in temperature of the air within a few inches of the surface of the ground over the bare soil and over a thick mat of grass is frequently as much as 10 or 12° on nights when radiation is rapid, and this, of course, is enough to make the difference between very severe freezing and no freezing whatever. This influence of a protecting coat of vegetation or other form of mulch, is like that of a mulch used to prevent deep freezing in the winter and rapid thawing in the spring.

While the first three factors of latitude, altitude, and distribution of land and water are the most influential in determining the general climate of the region, such as the average annual temperature, the average seasonal temperature, or the yearly precipitation, the cyclonic storms have the effect of modifying this general result in a way that affects agriculture to a very great extent. Hence, the cyclonic storm movement, or weather, should be considered as a modifying rather than as a primary cause of climate.

PART II.

THE CLIMATE OF WISCONSIN

TEMPERATURE

Mean Annual Temperature. As a result of: (1) the latitude of Wisconsin, (2) its location near the center of the continent, yet subject to the local influence of two large lakes, (3) the lesser influence of differences in altitude, and (4) the weather conditions, chiefly caused by cyclonic storms, the variation in temperature between different sections of the state is important. The mean annual temperature for the eighty odd stations scattered throughout Wisconsin is 43.3°. This average temperature varies from 48° for the southwest corner of the state to 39° for the northeast portion. Thus Wisconsin has a mean annual temperature resembling that of eastern England, eastern Germany, and southern Russia; though the summers, of course, are warmer than in England and Germany, and the winters colder. Figure 2 shows the mean annual temperature for Wisconsin.

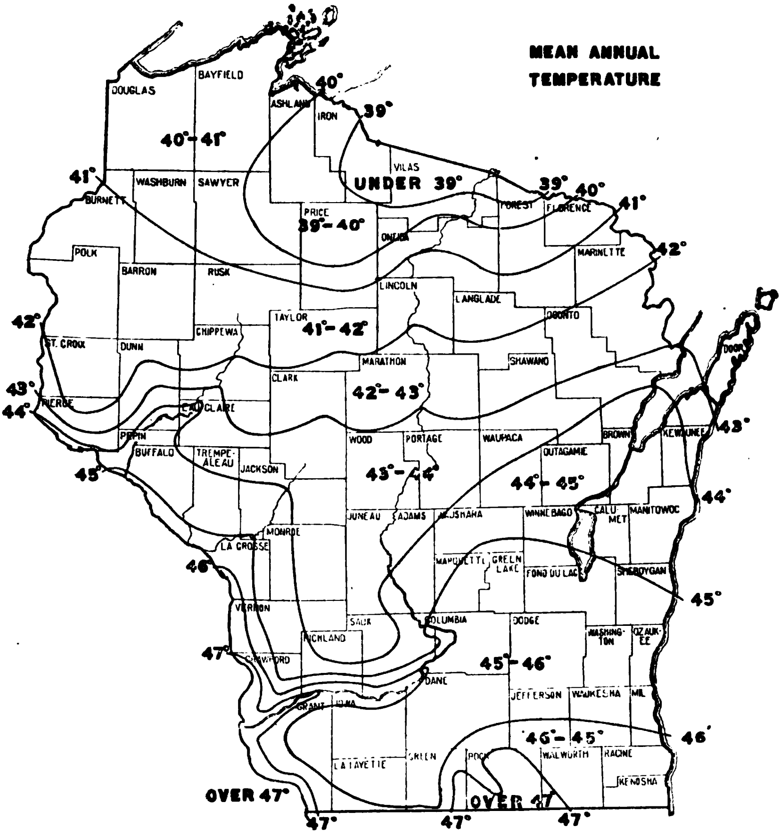

FIGURE 2. COMPARATIVE MEAN ANNUAL TEMPERATURE

The first five temperature maps are based upon the average of the highest (maximum) and lowest (minimum) temperatures each day during the fourteen years, 1897 to 1910 at about eighty stations of the U. S. Weather Bureau, scattered throughout Wisconsin. The influence of altitude, the lakes, and the larger topographic features, have also been considered.

Lines drawn through places having equal temperature, are known as isothermal (equal temperature) lines. Thus, in Figure 2, following the line of 44° it will be seen that Kewaunee, Oconto, Waupaca, Friendship, Baraboo, Richland Center, Sparta, Black River Falls, Eau Claire, Pepin, and Prescott have approximately the same average yearly temperature.

The decrease in temperature with latitude is evident in Table I, which shows the average of the mean annual temperatures for five stations along the southern border of the state, namely: Racine, Beloit, Brodhead, Shullsburg, and Dubuque; five stations through the middle of the state: Appleton, Waupaca, Grand Rapids, Neillsville, and Whitehall; five stations in northern Wiconsin; Grantsburg, Spooner, Hayward, Butternut, and Florence; and three stations on Lake Superior: Ashland, Bayfield, and Duluth.

TABLE I. AVERAGE TEMPERATURE AT DIFFERENT LATITUDES IN WISCONSIN

Stations	Average annual temperature	Miles north	Decrease in 100 miles
Southern Stations...............	47.2°	....	....
Central Stations	43.8°	130	2.6°
Northern Stations...............	40.5°	100	3.3°
Lake Superior Stations........	40.6°	60	0.10° (Increase)

The more rapid decrease in temperature from the central to the northern stations is due to increasing elevation, while the rise of temperature at the Lake Superior stations is likewise due to the rapid decrease in altitude; so that the difference between the southern and the northern boundary of the state is only 6.6° instead of 9° as would normally occur. This difference of 6.6° in 290 miles gives an average decrease of 2.3° per 100 miles.

The decrease in mean annual temperature along Lake Michigan as far south as Sheboygan, caused probably by cool lake currents, is also shown in Figure 2, where it will be noticed that the lines of equal temperature bend rapidly southward as they approach the lake, their eastern ends averaging 40 to 50 miles south of their western extremities in the Mississippi Valley, which has about the same elevation.

The influence of elevation upon mean annual temperature is, of course, less marked in Wisconsin than in states possessing mountain ranges, but Table II for stations in corresponding latitudes, proceeding from east to west over the highlands which extend from Lafayette to Ashland counties, shows an average decrease of one degree in 215 feet increase in elevation.

In the last instance the large difference in elevation overcomes the tendency of the cool lake at Ashland to lower the mean annual temperature. This decrease in temperature with elevation is greater in summer than in winter, the average of the stations mentioned in the table (except Ashland, subject to lake influence), being one degree for every 225 feet in winter and for 195 feet in summer.

TABLE II. INFLUENCE OF ALTITUDE ON TEMPERATURE

Each group of three are in the same latitude

Station	Feet elevation	Temperature	Difference in feet in elevation	Difference in temperature
Beloit	750	47.3°	269	1.1°
Shullsburg	1,019	46.2°		
Dubuque, Iowa	639	47.9°	380	1.7°
Madison	947	45.8°	252	0.7°
Mt. Horeb	1,226	45.1°		
Prairie du Chien	690	47.5°	536	2.4°
Portage	809	45.6°	191	2.0°
Hillsboro	1,000	43.6°		
La Crosse	714	46.1°	286	2.5°
Waupaca	857	44.0°	139	1.2°
Neillsville	996	42.8°		
Red Wing, Minn	708	43.9°	188	1.1°
Grantsburg	1,095	41.6°	413	1.9°
Butternut	1,508	39.3°		
Ashland	647	41.6°	861	1.9°

Seasonal Temperature. The average yearly temperature, however is not so important agriculturally as the seasonal variation. The mean winter temperature for the whole state is 17° (December 20°, January 14°, February 16°), ranging from 23.6° at Racine to 12.9° at Hayward.

The mean spring temperature is 42° (March 29°, April 43°, May 55°), ranging from 47.4° at Dubuque at 37° at Bayfield.

The mean summer temperature is 67° (June 65°, July 69°, August 67°), ranging from 71.4° at Prairie du Chien to less than 60° upon the outer Apostles' Islands.

The mean fall temperature is 47° (September 60°, October 48°, November 33°), ranging from 52° at Racine to 43° at Butternut.

The northern portion of the state averages about 8° cooler in winter than the southeastern portion, about 5° cooler in spring, about 4° cooler in summer, and about 6° cooler in fall. Southern Wisconsin has a summer temperature similar to that of central France, southern Germany, and the Danube Valley; while northern Wisconsin is about as warm in summer as London or Berlin. The winter temperature of the state, however, resembles that of Sweden and central Russia. Figures 3, 4, 5, and 6 show the mean seasonal temperatures for Wisconsin, while Figure 7, showing the mean summer temperature for the United States, is inserted for comparison.

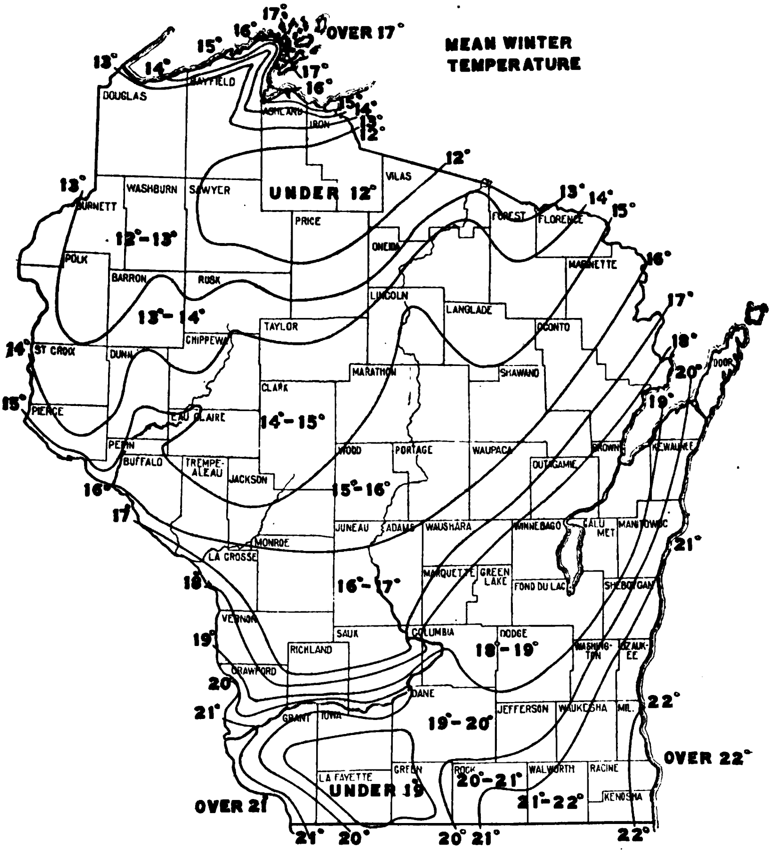

FIGURE 3. COMPARATIVE MEAN WINTER TEMPERATURE

Average of the daily maxima and minima for December, January and February.

This general decrease in seasonal temperature with latitude, however, as already explained, is greatly modified by the influence of Lakes Superior and Michigan, especially near

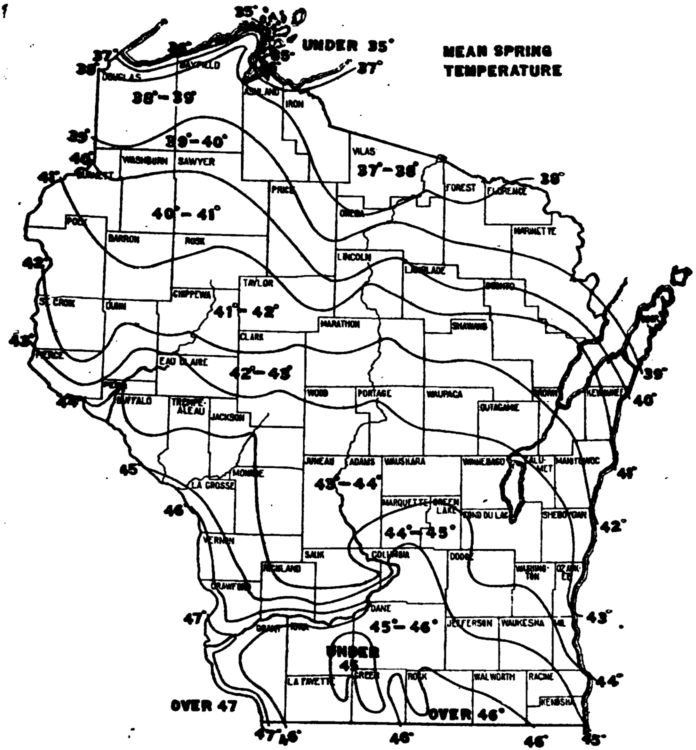

FIGURE 4. COMPARATIVE MEAN SPRING TEMPERATURE
Average of the daily maxima and minima for March, April and May.

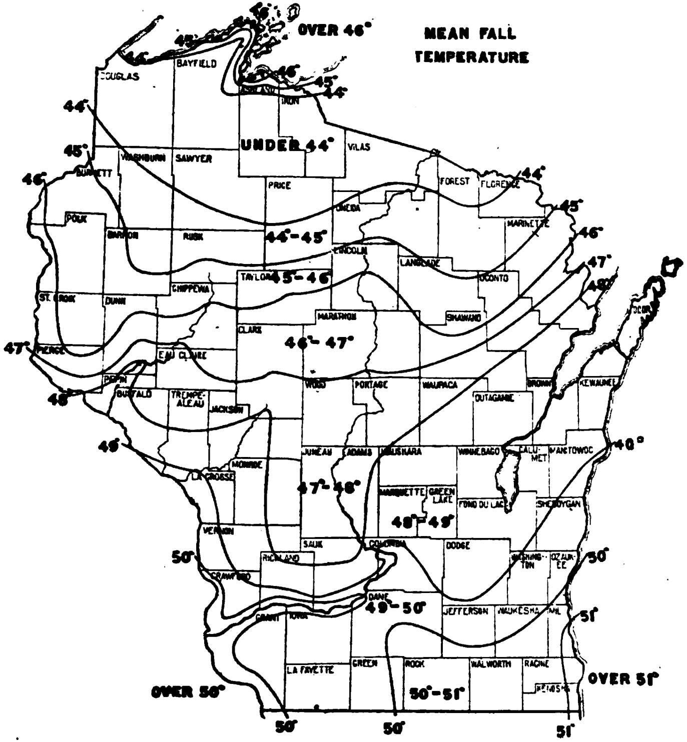

FIGURE 5. COMPARATIVE MEAN FALL TEMPERATURE
Average of the daily maxima and minima for September, October, and November.

their shores. Thus it will be noted on the maps showing the mean spring and mean summer temperatures that the lines which have a general east and west direction across the state, swing almost straight south as they approach Lake Michigan; while the lines on the fall and winter temperature maps reverse this direction and bend rapidly northeastward, the great heat absorbing capacity of water retarding the approach of both winter and summer, and equalizing the yearly temperature extremes. Thus, the mean May temperature is 59° at Beloit, and 54° at Milwaukee, having about the same latitude and elevation; 59° at La Crosse and 52° at Manitowoc; 55° at Grantsburg, and 50° at Bayfield. Or, expressing the fact in another way, Sheboygan and Port Washington

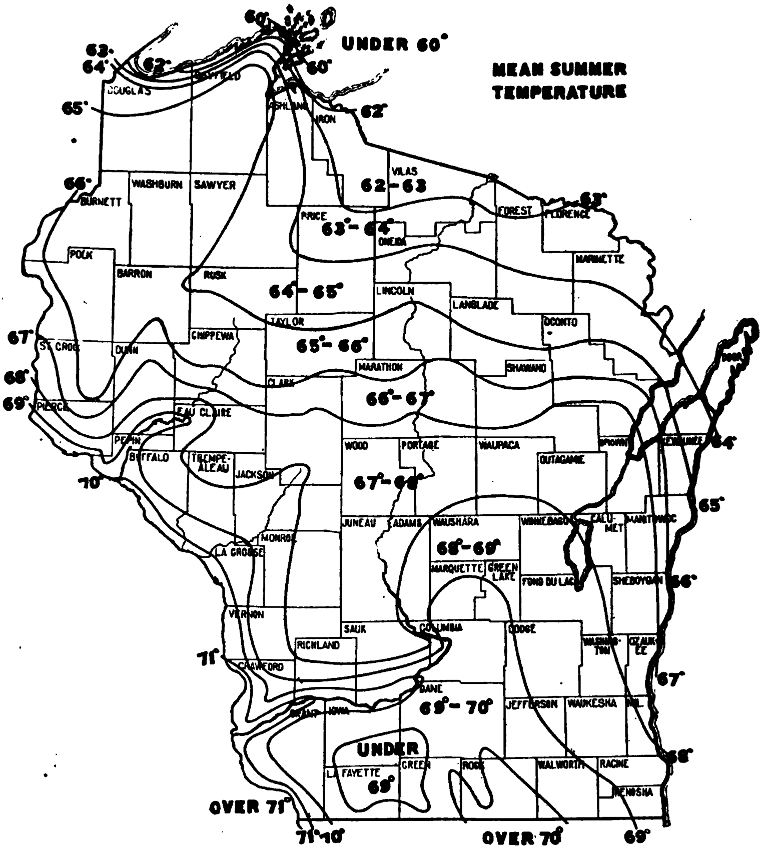

FIGURE 6. COMPARATIVE MEAN SUMMER TEMPERATURE

Average of the daily maxima and minima for June, July and August.

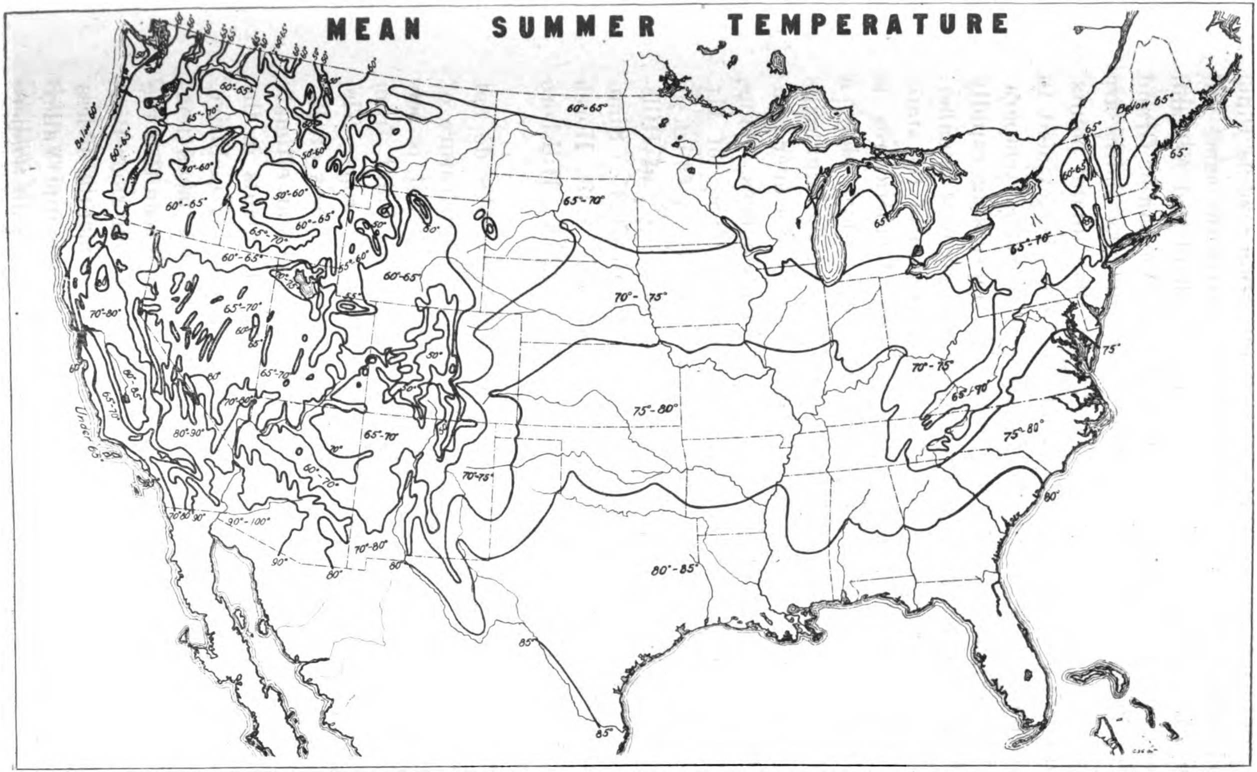

FIGURE 7. MEAN SUMMER TEMPERATURE.

This map, showing the mean summer temperature of the United States, is constructed from the various meteorological reports of the Weather Bureau combined with the topographic maps of the U. S. Geological Survey.
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show an average spring temperature about equal to Osceola in Polk county and colder than at St. Paul, Minn.; while Plum Island, at the end of Door Peninsula, possesses the same fall temperature as that of Dodgeville; and Bayfield and Ashland are about as warm in the autumn months as Wausau or Grand Rapids. In general, during the summer the lake shores are about 4° cooler and in winter 4° warmer than inland points. The equalizing influence of Lake Michigan is also evident in the distribution of the number of days of freezing temperature; the lake shore averaging 130 days, increasing rapidly to 150 days thirty miles inland, while the greatest number, about 185, is reached in the northwestern portion of the state.

The influence of altitude upon seasonal temperatures is less noticeable but still evident on the maps, which show a southward swing of the isothermal lines around the highlands of Richland and Sauk counties, with an island of cooler temperature centering in Iowa and western Dane counties. Thus, the mean summer temperature of Madison is 69.8°; of Mt. Horeb, in the Highlands, 68.6°; and of Prairie du Chien in the Mississippi Valley 71.4°; or of Sauk City 71.3°; of Hillsboro, in the Highlands, 67.3°; and of La Crosse 70.3°. Similarly, in winter the figures are: at Madison 19.5°; Mt. Horeb 18.1°; Prairie du Chien 21°; or of Sauk City 20.6°, Hillsboro 16.9°, and La Crosse 19.2°.

Effective Temperature. Since plants and vegetables do not germinate or show noticeable growth until a temperature of several degrees above the freezing point is reached, it is better to use 42° rather than 32° as the starting point from which to estimate the amount of heat required by crops. The mean temperature during the growing season in excess of 42° may be called "the effective heat." Figure 8 offers an estimate of the relative amount of this heat available to plants in the different parts of the state during April to September inclusive. This map was prepared by deducting 42° from the mean temperature for these six months at each station. It is seen that the highlands adjoining the Iron Ranges, and part of the Door Peninsula maintain a mean temperature during these months of less than 15° above this vital point. The lower Mississippi Valley receives the greatest amount of effective heat, the mean temperature at Dubuque and Prairie du Chien during this period being about 22° above this temperature of 42°.

Taking this lower Mississippi Valley as a standard, it will be noted that the northern highlands receive one-third less effective heat, while the Michigan shore and Northwestern Wisconsin average about one-fourth less heat, Kenosha county receiving about as much as Buffalo county, Sheboygan as much as St. Croix, while Barron and Washburn counties during these months are as warm as Manitowoc or Kewaunee, Marathon, or Taylor counties.

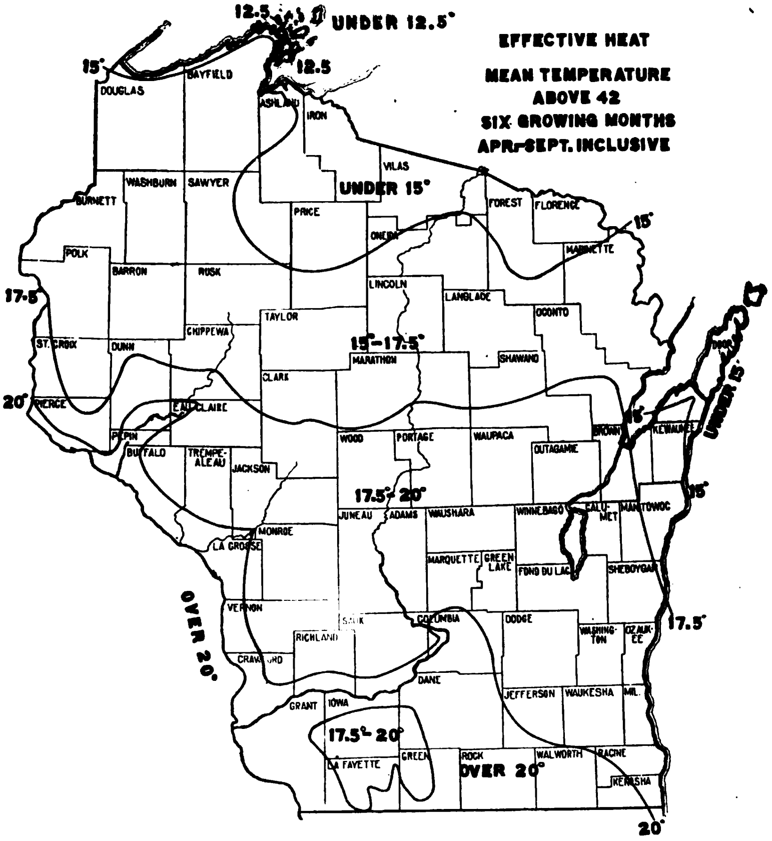

FIGURE 8. COMPARATIVE EFFECTIVE HEAT

Figure 9 shows the mean monthly temperatures for the state as a whole, for the northern and the southern portions, for the Michigan shore, and for the Mississippi valley. The dotted lines drawn across these diagrams at a temperature of 32° show the months contributing in the different portions of the state, any heat at all available to vegetation, while similar lines drawn across the diagrams at 42° would show the months during which the heat becomes effective, or of appreciable value.

Annual Temperature Extremes. The extreme annual range in temperature influences the comfort of the people as well as crop adaptations. The range is less along the eastern border and the Superior shore owing to the lake influence. Table III shows the average of the highest and lowest temperatures reached each year for the ten years 1902—1911 at the stations mentioned, and also the highest and lowest temperatures ever recorded.

TABLE III. ANNUAL RANGES IN TEMPERATURE IN WISCONSIN

Station	Average highest temp.	Average lowest temp.	Average yearly range	Highest recorded temp.	Lowest recorded temp.	Absolute range
Milwaukee	95°	—12°	107°	100°	—25°	125°
Manitowoc	95°	—16°	111°	100°	—32°	132°
Madison	94°	—17°	111°	104°	—29°	133°
Grand Rapids	95°	—30°	125°	100°	—38°	138°
Prairie du Chien	100°	—25°	125°	110°	—30°	140°
La Crosse	97°	—20°	117°	104°	—43°	147°
Barron	95°	—34°	129°	103°	—40°	143°
Florence	93°	—27°	120°	99°	—39°	138°
Ashland	96°		121°	104°	—33°	137°

This table shows wide ranges of temperature, characteristic of the interior of continents. The variation in different portions of the state, however, is due mainly to the lowest winter temperatures, since all sections experience hot days in summer, averaging throughout the state about 95°. Figure 10, shows that the coldest temperature reached in the average winter, varies from 15° below zero along Lake Michigan south of Sheboygan, to 35° and 40° below zero in the interior northwestern portion of the state. The highest temperature ever recorded in the state was 111° at Brodhead, Green Co.; and the lowest, 50° below zero at Hayward and also at Mauston.

Daily Range. Another important temperature factor is the heat of the day compared with the coolness of the night. Table IV for typical stations shows the means of the daily maximum and of the minimum, which in general, coincides with the average highest day and lowest night temperatures.

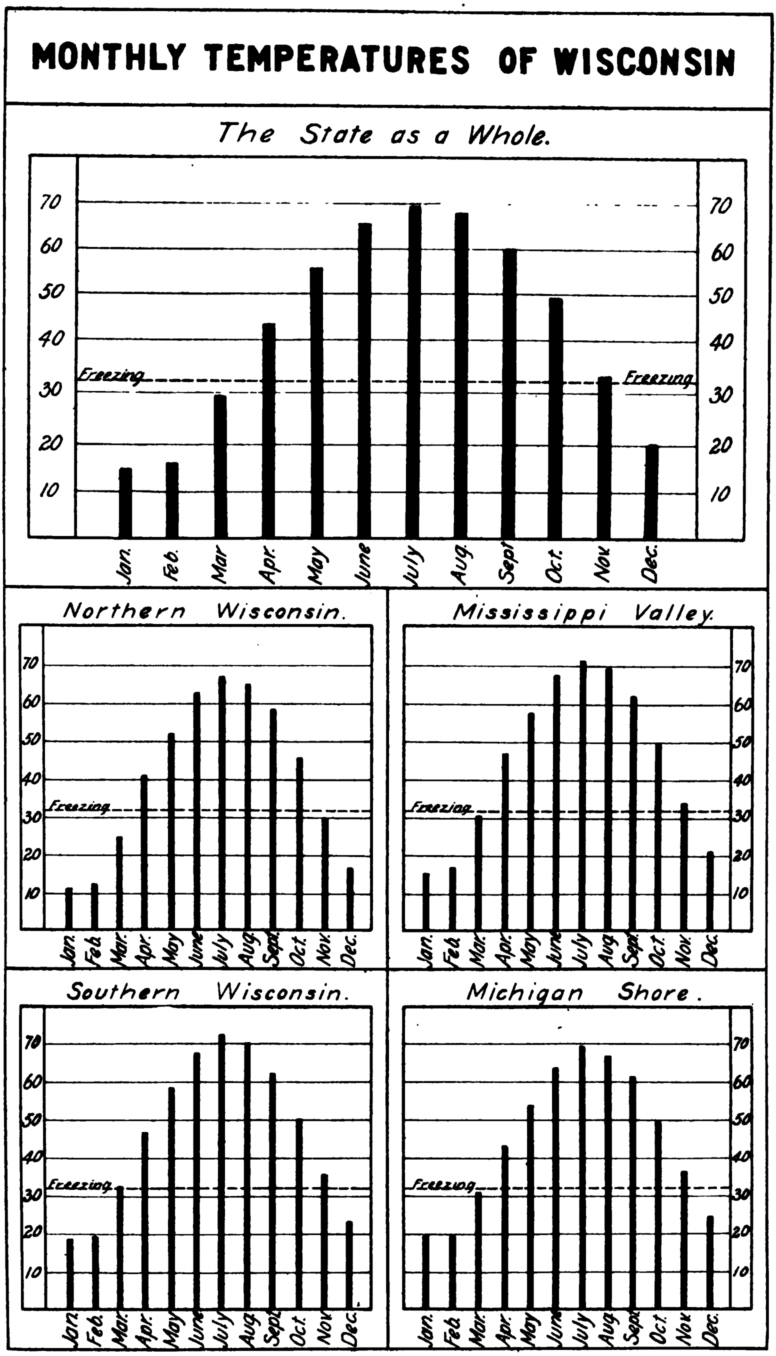

FIGURE 9. REGIONAL DISTRIBUTION OF TEMPERATURE IN WISCONSIN

This table shows clearly how the heat of the day and the cold of the night are moderated by lake influence, thus reducing the daily range. The first two stations are located on Lake Michigan, while Ashland and Bayfield are on Lake Superior. It also shows that while Milwaukee has a daily range less than New York City, Hayward has a daily range almost equal to Denver.

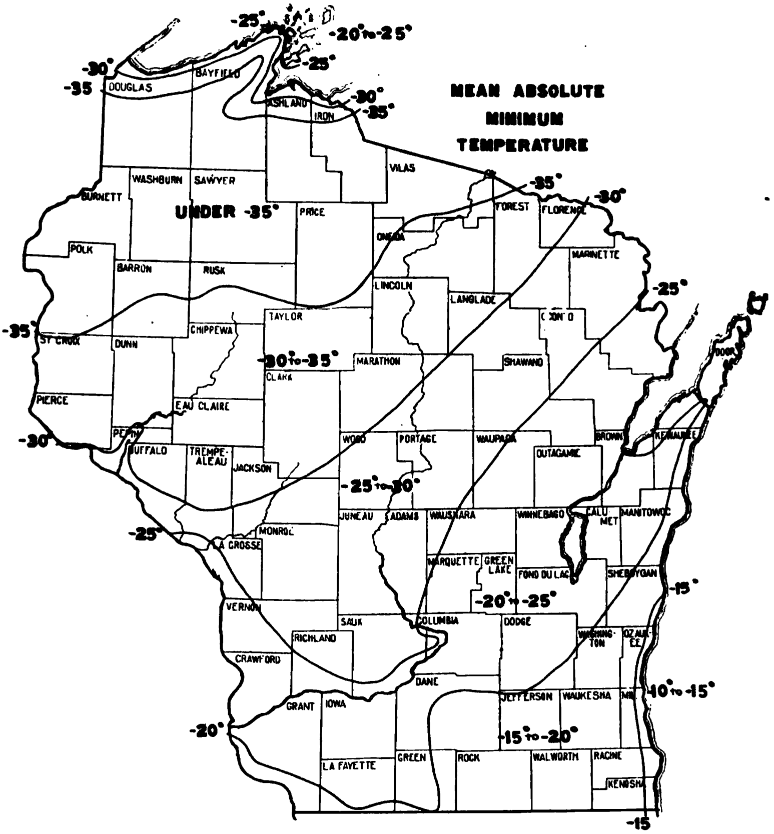

FIGURE 10. MEAN ANNUAL MINIMUM TEMPERATURE

This map shows the average of the lowest temperatures reached during the past ten winters in the different portions of the state.

Growing Season. Probably the most important temperature condition in relation to agriculture is the length of the growing season.[1] The length of time from frost to frost varies as widely in Wisconsin as in any other eastern state, ranging from 175 days at Dubuque to 75 days on the Iron ranges along the Michigan border. Thus, the length of the frostless period at Dubuque, Beloit, and Madison is as long as in the higher hills of Northern Georgia, or the Valley of Virginia; while 75 days is as short as that of Saskatchewan, eastern Oregon, or Alaska.

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[1] The phrase, "growing season," as used in this bulletin, means the number of days from the last killing frost in the spring to the first killing frost in the fall. Grasses, of course, begin growing in the

TABLE IV. SEASONAL MEAN DAILY RANGE IN TEMPERATURES AT TYPICAL STATIONS

Station	Winter			Spring			Summer			Fall		
	Mean highest	Mean lowest	Mean daily range	Mean highest	Mean lowest	Mean daily range	Mean highest	Mean lowest	Mean daily range	Mean highest	Mean lowest	Mean daily range
	°	°	°	°	°	°	°	°	°	°	°	°
Milwaukee	30	16	14	51	35	16	73	59	14	57	43	14
Manitowoc	28	12	16	50	32	18	75	54	21	55	38	17
Madison	26	12	14	54	36	18	79	61	18	54	38	16
Stevens Pt	26	6	20	55	33	22	81	55	26	57	36	21
Lancaster	26	8	18	57	35	22	83	58	25	59	37	22
La Crosse	27	11	16	55	37	18	80	61	19	58	40	18
Havward	24	0	24	54	28	26	80	53	27	54	32	22
Florence	24	6	18	51	28	23	77	51	26	53	33	20
Ashland	28	10	18	48	28	20	78	55	23	57	39	18
Bayfield	24	8	16	47	28	19	76	55	21	54	38	16
New York	39	25	14	51	41	16	80	65	15	63	48	15
Denver	44	18	26	61	35	26	84	56	28	65	37	28

Figure 11 shows the average date of the last killing frost in spring for Wisconsin, and Figure 12 the first killing frost in fall; while Figure 13 shows the length of this growing season for Wisconsin, and Figure 14 for the United States.

The combined effect of elevation and lake influence upon the length of the growing season is quite striking. Whereas the five Michigan shore stations at Racine, Milwaukee, Sheboygan, Manitowoc, and Kewaunee show an average season of 171 days; the five highland stations at Darlington, Mt. Horeb, Hillsboro, Hatfield, and Neillsville, lying at corresponding latitudes, average only 130 days. Similarly, the

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spring long before the last frost, and many other crops like roots and rape continue growing in autumn long after the first frost. But for corn and many staple crops, this frost to frost period approximates the true duration of their growth and as the frost records are the only data available for the purpose their use is justified.

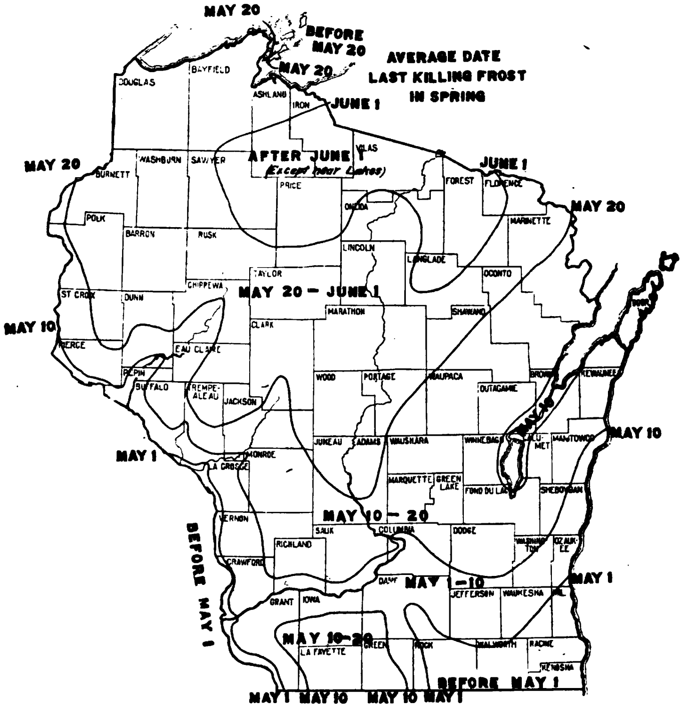


FIGURE 11. LAST KILLING SPRING FROST

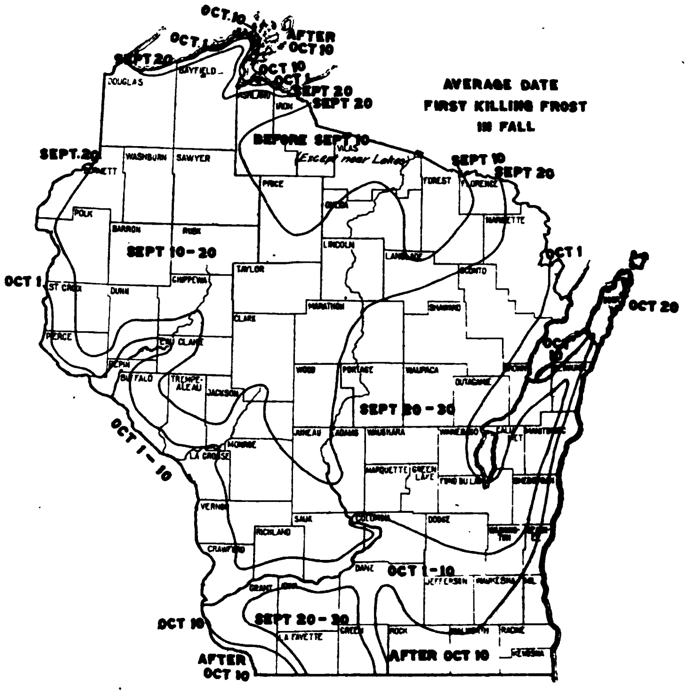


FIGURE 12. FIRST KILLING FALL FROST

These maps have been prepared from the original monthly reports of the observers of the U. S. Weather Bureau for the past 12 years, supplemented by private records loaned to the authors.

average growing season for Duluth, Superior, Bayfield, and Ashland is 139 days; while the average of the northern highland stations at Solon Springs, Hayward, Butternut, and Vaudesare, though located further to the south, is 95 days.

Figure 13 showing the length of the growing season exhib-

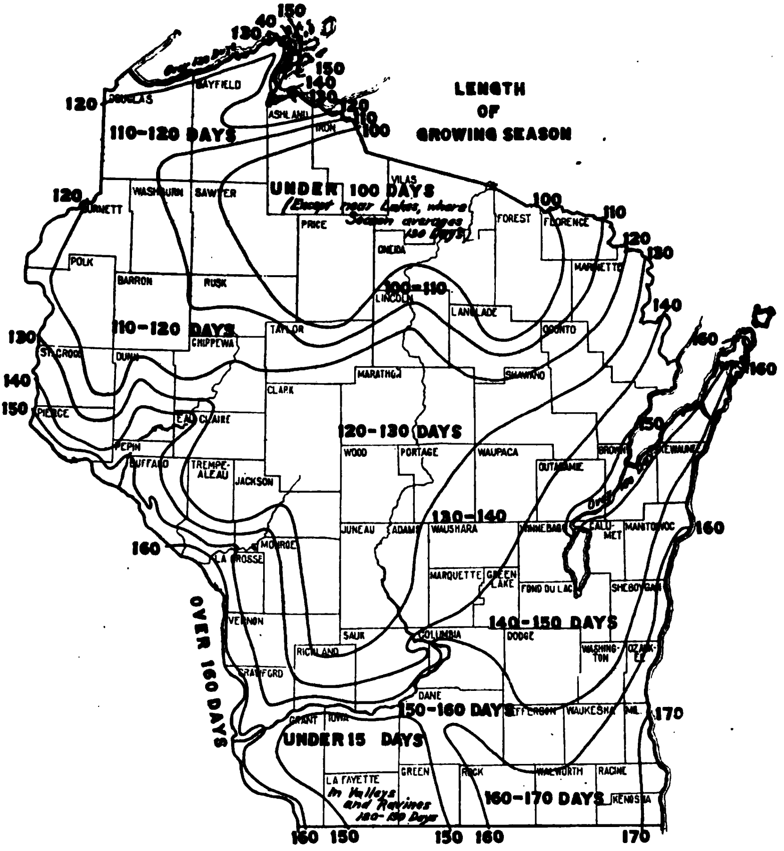


FIGURE 13. COMPARATIVE LENGTH OF GROWING SEASON

This map shows the average number of days between the last killing frost in the spring and the first in the fall for twelve years, 1899 to 1910.

its many interesting features. First, it appears that a section of Rock and Dane counties, roughly including the tobacco region, possesses an average growing season of about 170 days, which is four weeks longer than the cheese producing regions to the west, and three weeks longer than Dodge and Fond du Lac counties to the north. This longer season in the Rock River basin is doubtless due to its lower elevation and

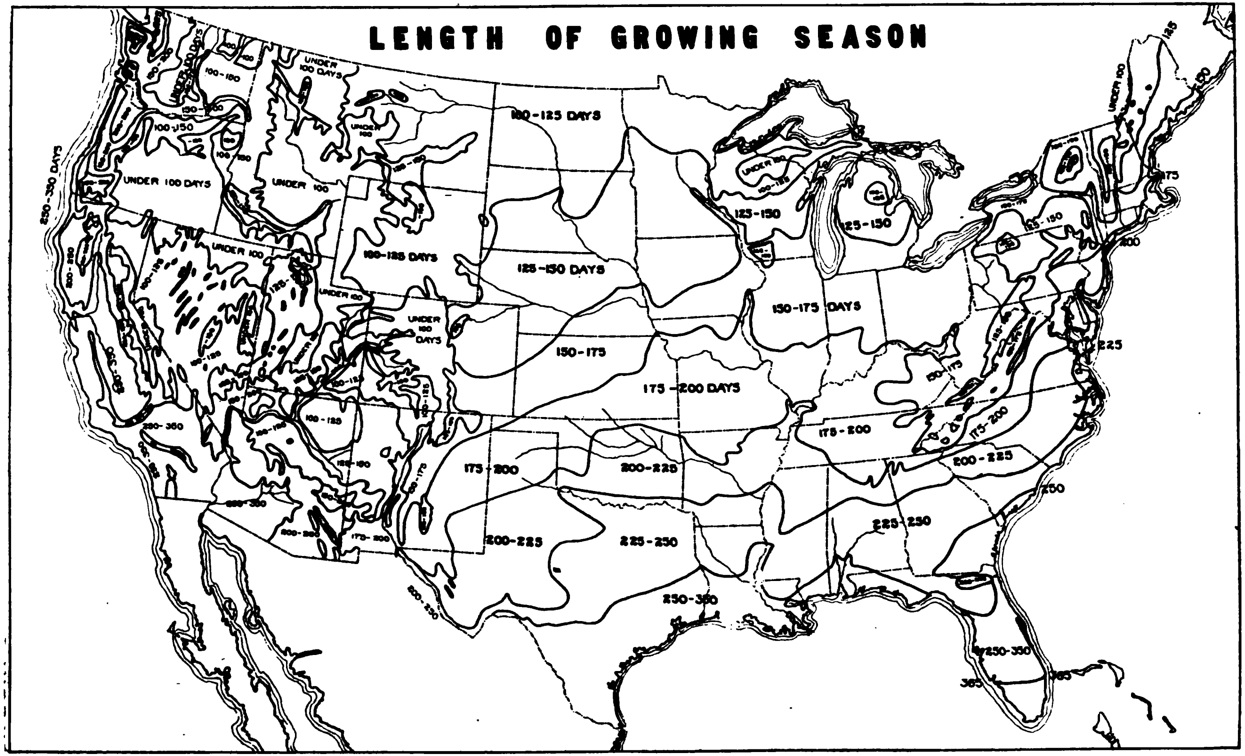


FIGURE 14. LENGTH OF GROWING SEASONS IN THE UNITED STATES

This map, showing the average number of days between the last killing frost in spring and the first in fall, is constructed from the climatic records of the Weather Bureau combined with the topographic maps of the U. S. Geological Survey. Copyright applied for by O. E. Baker, 1912.

protection by the higher land to the west and the lake upon the east, while the increasing elevation and latitude to the north assist in explaining the shorter season on this border.

The cheese region of western Green, Lafayette, and Iowa counties, owing doubtless to its elevation and perhaps more rapid radiation, possesses a comparatively short growing season, the average of the four stations at Dodgeville, Mt. Horeb, Darlington, and Shullsburg being only 140 days. Passing down into the Mississippi River Valley we come to a warmer region and longer growing season, averaging 171 days for Dubuque and Prairie du Chien; while the stations further north at La Crosse, Wabasha, Winona, and Red Ring, average over 160 days.

One of the most noticeable features of the growing season map is the southward swing of the lines to include the hilly sections of Jackson, Richland, and Juneau counties, together with the adjoining Wisconsin River Valley, thus showing the same general trend as the temperature lines. This is doubtless due in part to the elevation in the hill country, and in part to the soil of the Wisconsin Valley being frequently sandy. The average growing season in this region, which includes the potato section, is 130 days. The Michigan shore possesses a longer growing season, ranging from 147 days at Oconto and Menominee to 171 days at Racine. Sturgeon Bay has a record covering only seven years, nevertheless, unless the station record is impaired by local influence; the Door Peninsula appears to have a very retarded spring, the mean date for the last killing frost being May 26, thus reducing the average growing season to 137 days.

Passing now to the northern portion of the state, we find the length of the growing season gradually shortening as we approach the head-waters of the streams until a minimum of about 75 days is reached in Vilas county. This is due doubtless mainly to the latitude and altitude, and also in part probably to the extensive forest cover and the sandy soil. It is altogether probable that as this section is cleared, securing better air drainage, and the marshes are drained and cultivated so they can absorb the sun's heat better, it will be less subject to irregular summer frosts and the general length of the growing period will be somewhat increased. Descending to the

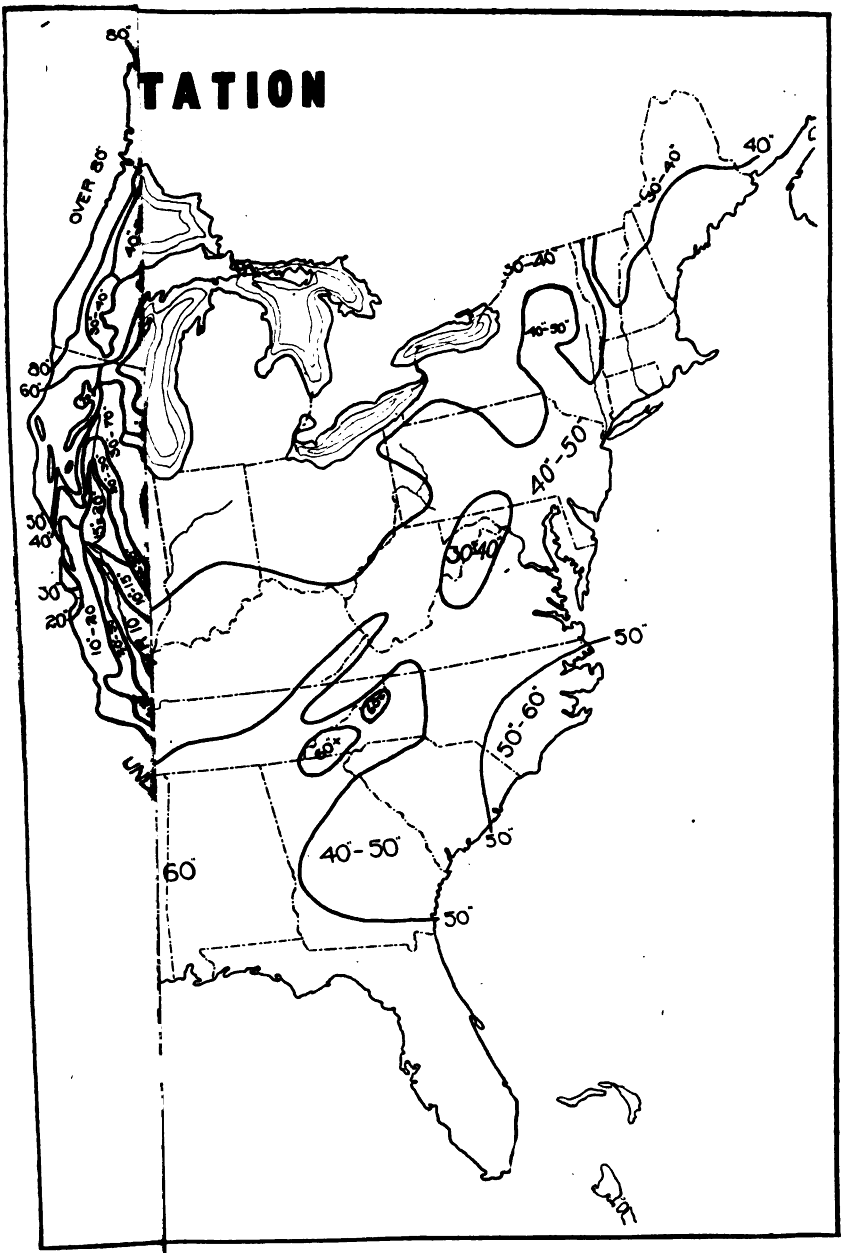
Lake Superior shore, the growing season increases rapidly in length, reaching 126 days at Ashland, 135 days at Bayfield, and probably 150 days on the Apostle Islands.

RAINFALL AND SUNSHINE

Annual Distribution of Precipitation. The distribution of the rainfall over Wisconsin is remarkably uniform. All but four of the eighty odd stations show an average yearly rainfall of 28 to 34 inches, while the mean for the whole state is 31 inches. This is a slightly heavier rainfall than is received by eastern England, northern France, most of Germany, Sweden, and the Danube Valley. As compared with other portions of this country, Wisconsin has a total rainfall equaling that of central Oklahoma and Kansas, northern Iowa, Michigan, northwestern New York, or the Puget Sound basin of Washington. But owing to its northerly location, the lessened evaporation probably makes the precipitation as effective as that of Arkansas, Illinois, or Virginia. Figure 15, showing the mean annual precipitation for the United States, permits a comparison of Wisconsin with other portions of the country.

In general, the heaviest rainfall in Wisconsin occurs on the southern highlands of Lafayette and Richland counties, which average 34 inches, and to a less extent on the north-central highlands, most of which in the winter months is in the form of snow; while a region around Lake Winnebago and that along the Superior shore, lying in the lee of higher lands, have the lightest rainfall, with an average of 29 inches. Thus the three Mississippi Valley stations at Dubuque, Prairie du Chien, and La Crosse, having an altitude of about 700 feet, averaged during the years 1897-1909 inclusive, 31.5 inches of precipitation; while Shullsburg, Mt. Horeb, Viroqua, and Hillsboro, with an average altitude of over 1,100 feet, received an average rainfall of nearly 35 inches. The increase of 400 feet in elevation apparently produced an increased precipitation of 3 to 4 inches or 1 inch in 100 to 130 feet. Likewise, the descent from Butternut, with an elevation of 1,508 feet, to Ashland, with an elevation of 637 feet, appears to result in a decrease of 5 inches of rainfall in the 870 feet, or 1 inch in 170 feet.

The local distribution of rainfall varies, however, from year to year, some sections receiving more rainfall one year, and



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STATES

pographic maps of the U. S. Geological Survey.
approximately coincide, hence, division of areas

other sections more in other years. This variation is caused by the movement of the cyclonic storms as explained on page 10. Frequently, heavy showers accompanying these storms affect only small areas. During 1910 the average precipitation for the entire state was only 21.4 inches, ranging from 11 inches at Osceola to 33 inches at Sturgeon Bay. This was the driest year in the history of Wisconsin. In the years 1903, 1905, and 1906, on the other hand it averaged 35 inches, while in 1911, the state averaged 37 inches. The greater extremes of rainfall occur in the northwestern portion, ranging from an average of 15 inches for the driest year to 45 inches for the wettest; while the Michigan slope experiences the least variation, ranging from 20 inches for the driest to 40 inches for the wettest year.

Seasonal Distribution of Precipitation. Of equal importance in agriculture, to the total rainfall, is its seasonal distribution, and in this respect Wisconsin is unusually fortunate, since about half of the total rainfall comes in May, June, July, and August, and nearly 70% from April to September, inclusive. June has the heaviest rainfall, averaging 4.1 inches, while July averages 4 inches and May 3.9 inches. The precipitation during the winter, on the other hand, is slight; December, January, and February each averaging from 1 to 1.5 inches of rain and melted snow. The average rainfall for the state during winter is 3.9 inches, during spring 8.3 inches, during summer 11.4 inches and during autumn 7.4 inches. Figure 16 shows the monthly distribution of precipitation for Wisconsin, and for different sections of the state. Figure 17 shows that most of the rainfall occurs just preceding and during the period of plant growth, thus being received by the crop at the most effective time. Wisconsin receives during the growing season, April to September inclusive, an average of 21 inches of precipitation, which is as much rain as that received during the same months by eastern Texas, Illinois, Ohio, or eastern New York. The small winter precipitation in Wisconsin, mostly in the form of snow, on the other hand, causes virtually no leaching of fertility from the soil, or erosion.

The ten northernmost stations in the state average in the winter, 3.4 inches, which is nearly an inch less than that of the ten southern stations; and during spring the north with 7.8 inches averages over an inch of rain fall less than the south;

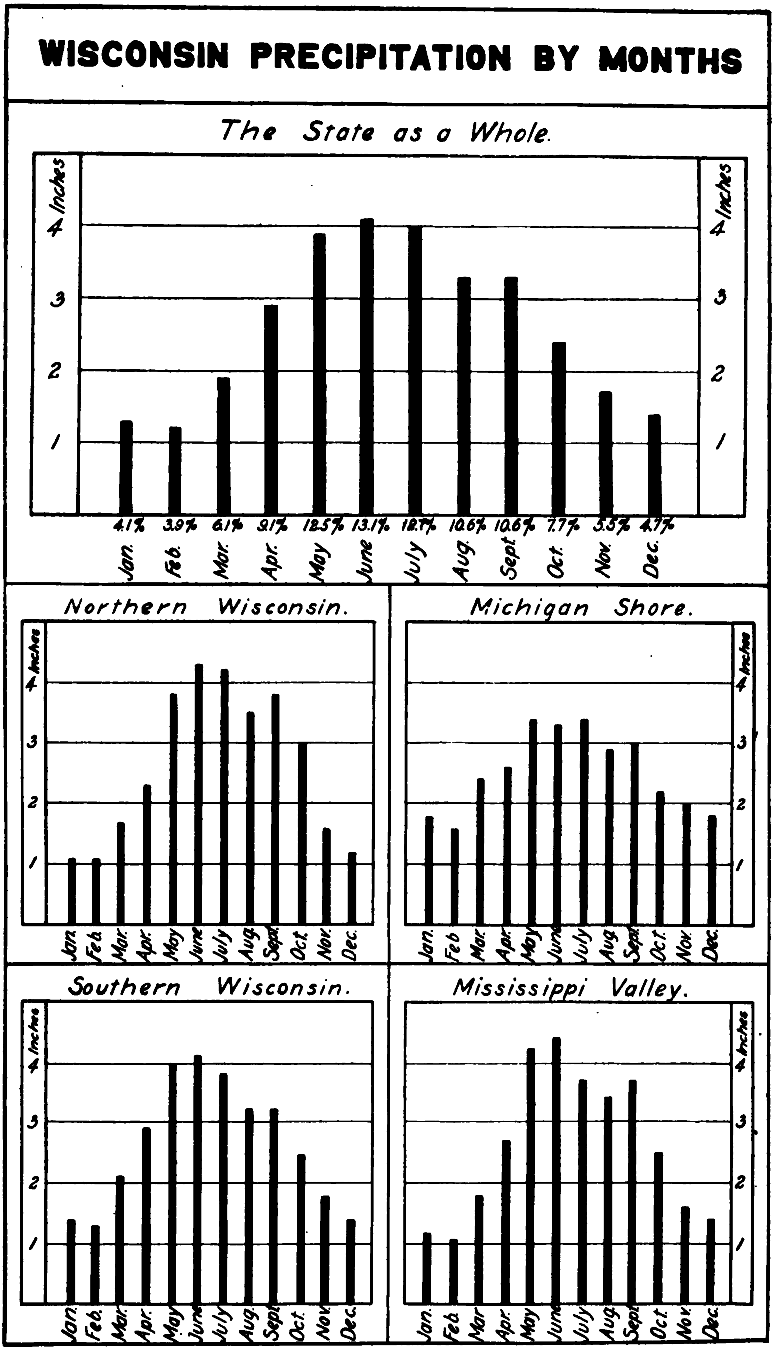

FIGURE 16. REGIONAL DISTRIBUTION OF RAINFALL IN WISCONSIN

while during summer the north with 12 inches receives nearly an inch more rain; and also during the autumn the northern rainfall of 8.4 inches exceeds the southern by about an inch. This heavier summer and autumn rainfall in the north explains in part the excellent pasturage there; while the drier winters and springs enable the farmer to get on the land earlier than he otherwise could.

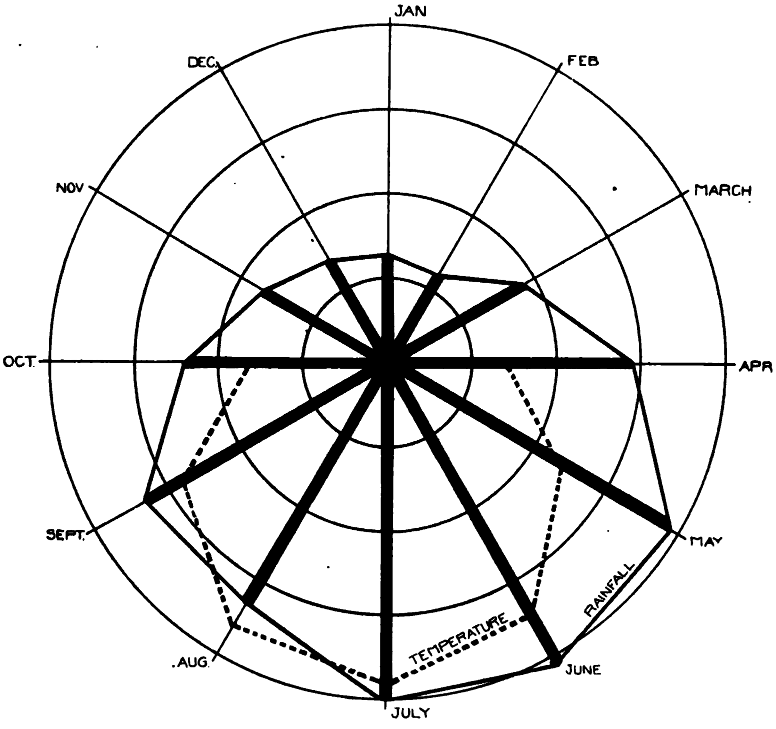

FIGURE 17. RAINFALL AND TEMPERATURE

This chart is arranged to show how most of the rainfall of the state occurs just preceding and during the season of growth. The heavy radiating lines represent monthly rainfall, and the distance from the center the amount, each successive circle equalling an inch of precipitation. Similarly the distance on these heavy lines from the center to the intersection with the dotted lines represents the amount of effective heat, each circle equalling 10 degrees of temperature above freezing.

The distribution of rainfall on the shore of Lake Michigan as compared with the Mississippi Valley is also interesting in that 14% of the total precipitation comes in the winter and 31% in summer at the lake stations, while the Mississippi Valley receives only 11% in winter and over 36% in summer.

Figure 18 which shows the seasonal distribution of precipitation for the North Atlantic (hay region), Southern (cotton belt), and Northern Pacific sections of the country is given for comparison. The high efficiency of the summer Wisconsin rainfall as contrasted with the low efficiency of the winter rainfall along the Pacific coast, is worthy of consideration, especially by those who contemplate emigrating to the West. These four types of rainfall: the even distribution of the northeastern states, the maxima in both summer and winter in the south, the summer maximum of the north central states, and the winter rainfall and summer drouth of the Pacific coast, exercise a powerful influence in determining agricultural practice.

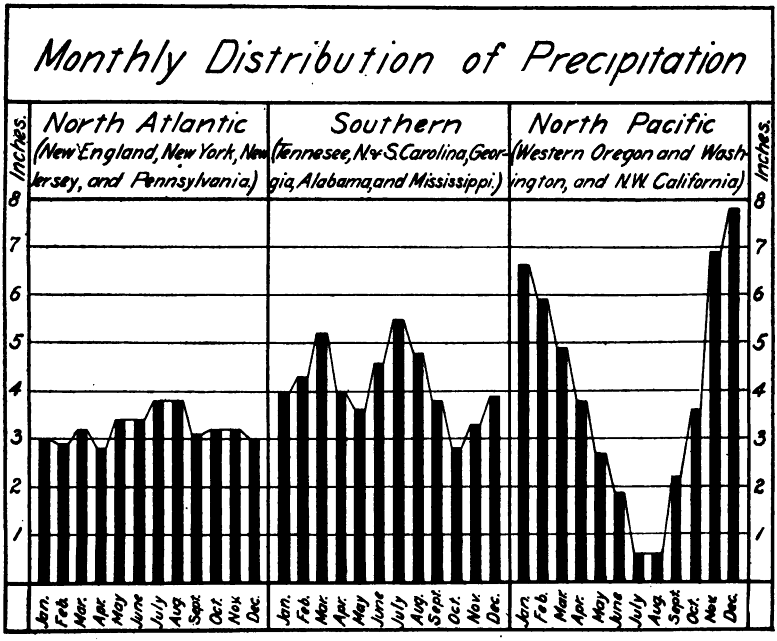

FIGURE 18. REGIONAL DISTRIBUTION OF RAINFALL

Drouths. Another phase of rainfall distribution of great importance is its variation within a period of a few weeks. Frequently periods of drouth and periods of unusually heavy rainfall occur, continuing for one to four weeks and occasionally longer. These periods of drouth and of heavy rainfall are believed to be caused by the movement of cyclonic storms as explained on page 9. Table V, giving the rainfall at Madison by ten-day periods for the thirty years, 1882 to 1911 inclusive, shows this variation:

From this table it will be seen that there are many ten-day periods and frequently 20 days or even more, within which only a fraction of an inch of rain falls.

TABLE V. RAINFALL IN TEN DAY PERIODS FROM APRIL TO SEPTEMBER 1882 TO 1896 AT MADISON

	1882	1883	1884	1885	1886	1887	1888	1889	1890	1891	1892	1893	1894	1895	1896
Apr. 1-10	2.51	.....	1.54	0.99	0.12	0.00	1.28	0.19	1.03	0.38	2.07	1.02	0.81	1.06	0.69
Apr.11-20	1.44	.....	2.56	1.49	1.00	0.20	0.15	1.06	1.13	0.54	0.48	2.21	0.98	0.00	2.19
Apr.21-30	0.26	.....	0.71	0.97	1.52	0.80	0.92	0.46	0.06	0.53	1.39	1.31	1.83	0.00	0.56
May 1-10	1.19	1.31	3.11	0.34	1.48	0.99	1.53	0.45	3.01	0.07	3.95	1.12	1.57	1.31	1.30
May11-20	0.91	3.02	0.25	0.36	0.53	0.55	1.46	1.42	1.23	0.00	1.31	0.30	1.42	0.91	2.56
May21-30	0.34	2.65	0.85	0.98	0.01	0.43	0.67	1.14	0.79	1.33	0.79	0.62	0.42	0.38	2.26
May 31- June 9..	2.04	5 03	1.52	3.54	0.49	0.24	0.00	0.69	3.26	1.23	3.93	1.61	0.00	0.26	0.93
Jun 10-19	1.15	2.09	1.21	0.54	0.30	0.57	2.21	1.14	2.52	0.77	2.64	4.31	1.83	0.21	0.81
Jun 20-29	2.95	0.45	1.84	1.03	0.29	0.06	0.64	0.17	1.69	1.70	2.00	1.01	2.11	0.27	0.82
June 30 July 9...	4.17	1.78	3.02	2.16	0.41	4.26	1.24	0.51	0.47	1.85	1.01	2.77	0.00	0.02	0.77
Jul. 10-19	0.05	2.26	0.21	1.74	0.14	1.11	1.17	0.49	0.81	0.02	0.15	1.64	2.04	0.55	0.41
Jul. 20-29	0.01	4.85	5.15	3.37	0.24	0.27	0.72	1.12	0.78	0.80	0.96	0.23	0.31	0.46	2.39
July 30- Aug. 8...	2.60	0.40	1.62	2.80	0.38	0.23	0.74	0.55	1.50	0.18	0.51	0.04	0.25	0.07	0.27
Aug. 9-18	3.57	0.37	0.72	0.64	3.36	3.09	0.39	0.05	1.11	0.19	0.24	1.38	0.65	0.01	1.25
Au. 19-28	0.05	1.97	1.91	2.70	1.53	0.66	0.27	0.12	1.62	0.76	2.84	0.00	0.00	1.54	0.96
Aug. 29- Sept. 7..	2.41	0.93	2.32	0.34	0.27	2.84	0.20	1.32	1.01	0.29	0.76	0.00	1.62	0.08	0.40
Sept. 8-17	0.53	0.54	1.37	3.24	0.76	1.24	0.56	0.38	0.38	0.00	2.51	0.00	2 30	0.35	2.07
Sep.18-27	0.06	0.92	0.51	0.22	1.34	1.26	0.28	0.23	0.23	0.00	0.01	1.07	0.00	0.01	1.01
Season total.....	26.24	28.57	30.02	27.45	13.87	19.80	13.43	11.49	22.63	10.64	27.55	20.63	18.14	7.49	21.68

TABLE V (Continued). RAINFALL IN TEN DAY PERIODS FROM APRIL TO SEPTEMBER 1897 TO 1911 AT MADISON

	1897	1898	1899	1900	1901	1902	1903	1904	1905	1906	1907	1908	1909	1910	1911
Apr. 1-10	0.27	0.21	0.10	0.00	0.22	0.19	0.72	0.56	0.61	0.88	1.74	0.79	0.23	1.49	0.86
Apr.11-20	0.81	1.61	0.06	1.37	0.12	0.43	1.40	0.00	0.45	0.00	0.14	0.42	3.48	1.03	0.68
Apr.21-30	1.42	0.56	2.54	0.00	0.00	0.55	0.76	0.83	0.37	0.02	1.12	3.20	3.48	2.04	0.30
May 1-10	0.28	1.41	1.05	0.91	0.89	1.97	0.66	2.93	2.17	0.98	0.81	0.64	0.07	0.75	0.54
May 11-20	0.32	2.55	1.01	0.82	0.00	1.47	0.08	0.92	2.87	0.46	0,47	2.30	1.98	0.98	0.94
May 21-30	0.14	0.75	2.72	0.13	1.43	1.72	3.62	1.18	1.26	1.91	2.12	2.44	0.19	1.09	1.15
May 31— June 9...	0.79	0.11	1.03	0.76	0.16	1.18	0.13	0.52	1.03	1.53	1.65	0.45	1.38	0.62	1.42
Jun.10-19	1.29	1.58	1.16	1.07	1.97	1.39	0.53	0.48	1.36	0.86	0.39	0.60	0.64	0.39	1.46
Jun.20-29	1.95	2.87	0.45	1.37	0.29	1.28	0.20	1.51	0.36	2.08	0.77	0.24	1.01	0.30	0.76
June 30— July 9....	0.65	0.29	2.54	2.74	0.12	4.31	2.83	2.74	1.29	0.23	1.52	1.63	0.16	0.00	0.80
Jul. 10-19	0.46	2.55	0.48	2.92	0.41	2.28	3.81	0.31	0.94	1.23	1.93	1.43	0.05	0.53	0.11
Jul. 20-29	0.67	0.10	0.24	1.45	1.07	2.41	1.61	0.21	0.01	0.38	2.39	0.00	0.08	0.28	0.40
July 30— Aug. 8...	0.82	0.95	2.16	0.10	0.00	0.42	1.62	0.38	0.47	6.07	0.93	0.01	0.10	0.14	1.03
Aug. 9-18	0.70	1.20	0.37	0.75	0.85	0.58	1.99	0.52	0.86	0.46	0.82	1.91	3.63	1.12	2.96
Au. 19-28	0.32	0.44	1.01	1.76	0.52	0.07	1.24	2.59	0.87	0.98	1.77	0.00	0.66	4.82	0.17
Aug. 29— Sept. 7...	0.68	0.49	0.30	0.09	0.00	1.25	1.37	2.88	0.78	0.44	0.39	0.61	0.72	1.09	0.31
Sept. 8-17	1.67	1.02	0.46	0.62	3.43	0.02	2.33	0.18	0.05	0.43	2.79	0.13	1.23	0.16	3.18
Sep. 18-27	0.00	0.04	2.65	0.79	0.00	0.18	0.55	1.02	0.03	0.47	1.22	0.57	0.25	1.06	1.89
Season total	13.24	18.73	20.33	17.65	11.64	21.70	25.45	19.76	16.78	19.41	23.03	17.37	16.34	17.89	18.96

While the agriculture of this state is entirely carried on without irrigation, and doubtless always will be, largely, yet it is true that additional water at these drouth periods would greatly increase yields. Based on the experiments in irrigation conducted by Prof. King at the Madison Experiment Station, we have estimated that during this period of thirty years there were on the average 2.4 times each year when irrigation would be beneficial; and assuming that three inches of water should be applied for such irrigation, this would call for 7.2 inches additional rainfall on the average in order to secure the maximum crops of which soil in the highest degree of fertility is capable.

Intensity of Precipitation and Distribution of Rainy Days. With the same total precipitation, there is a great difference whether the rain falls uniformly through a long period or quickly in the form of storms; the duration of rainfall being, therefore, often as important as the amount of rain, since with torrential rains following drouths, much moisture is lost by flowing off the parched soil, and severe erosion may occur.

Mr. E. R. Miller, Local Forecaster of the Weather Bureau, has investigated the intensity of the rainfall at Madison, and finds that during the past twenty years, four times in the average year Madison received a daily rainfall of over one inch, and in each three years, on the average, there have been two rainfalls exceeding 2 inches in the twenty-four hours. The average annual number of rainy days in the state is 94; the Lake Michigan stations recording the greatest number, 100, while the Southern Highlands with 80, and the northwestern portions of the state averaging 75, have apparently the fewest rainy days. Relative to seasonal distribution, the winter months throughout the state average about five days in which rain or snow falls each month, the spring months about eight, the summer months about nine, and the fall months about seven days.

Is Wisconsin Becoming Drier? It is the belief of many, based in part doubtless on the dry summers of 1908 and 1910, that the rainfall in Wisconsin is gradually decreasing in amount. Table VI compiled for the stations having the longest records in the state, shows the average precipitation figured for five-year periods. The decade 1875 to 1885 is characterized by an extraordinarily heavy rainfall especially at Beloit, Dubuque and Madison, but aside from this period, there is no adequate evidence of a diminishing precipitation.

Figure 19 constructed from the combined records of Milwaukee and St. Paul since 1844, leads to the same conclusion.

TABLE VI. MEAN YEARLY PRECIPITATION IN INCHES FOR 5-YEAR PERIODS

PERIOD	Milwaukee	Manitowoc	Beloit	Madison	Dubuque	La Crosse	Duluth
1866–1870	30.4	29.8	27.1	....	....	....	....
1871–1875	31.1	29.0	29.4	26.2	....	....	32.7
1876–1880	37.8	30.3	37.5	37.0	40.0	35.3	35.6
1881–1885	32.0	37.6	37.7	45.3	42.2	34.4	30.8
1886–1890	29.4	30.1	31.5	29.6	32.5	26.8	29.1
1891–1895	30.1	26.8	32.3	26.2	29.2	26.7	27.0
1896–1900	29.1	26.4	31.8	28.3	33.5	30.2	26.3
1901–1905	28.6	30.6	30.1	28.6	28.7	32.0	28.2
1906–1910	29.2	29.1	25.3	28.7	27.6	30.5	28.0

Snowfall. The average annual snowfall of Wisconsin is about 45 inches, varying from 33 inches in 1903 to 71 inches in 1909. This snowfall is generally heavier along Lake Michigan and in the northern portion of the state, where it averages 53 inches, while the central portion averages only 36 inches, and the southern portion 40 inches. In the northern part of the state the ground generally becomes permanently covered with snow about December 1, which remains until April 1, with an average depth of about 1 foot during the winter, though a depth 2 and even 3 feet is often attained by the

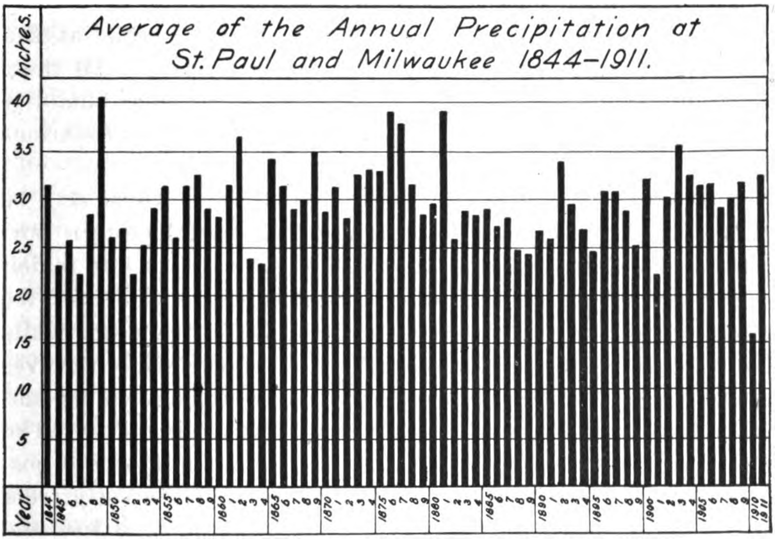

FIGURE 19. SEVENTY-EIGHT YEARS OF RAINFALL

middle of February. In the southern part of the state, slight thaws frequently clear the ground several times during the winter, but another snowfall usually precedes a cold wave and protects the winter grain.

Relative Humidity. Only four stations in the state and two others on its borders record the relative humidity: Milwaukee, Green Bay, Madison, La Crosse, Dubuque, and Duluth; but these are well located to show both water and land influence. The annual average for these six stations is 75%, ranging from 73% at La Crosse to 80% at Milwaukee. The average at 8 a. m. is 81%, ranging from 78% at Green Bay to 88% at Milwaukee; while the average at 8 p. m. is 70%, ranging from 66% at La Crosse to 72% at Milwaukee. The lowest relative humidity is attained during May at Milwaukee with an average of 72%, at Duluth 70%, Green Bay 68%, and Madison 66%; but during April at Dubuque and La Crosse, where the averages are 68% and 64% respectively. The highest average relative humidity is attained at Duluth in December (80%), during January at Milwaukee (79%), Green Bay (78%), Madison (82%), and La Crosse (79%); while at Dubuque it is not reached until February with 81%. All these stations thus exhibit approximately equal relative humidity during the winter, but during the summer the inland stations have a drier atmosphere.

Sunshine. The sunshine records at St. Paul, which may be taken as approximating conditions in the northwestern portion of the state, indicate that the sun shines upon this region about half of the possible time during winter, and 3/5 of the time during the summer, averaging 54% for the year; while Milwaukee, in the southeastern section of the state, receives about 40% of the total possible sunshine during winter and 56% during the summer, the yearly average being 47%. The sun smiles upon Wisconsin, therefore, about half of the possible time during the year, which does not differ greatly from the duration in eastern New York, central Ohio and Indiana, or eastern Washington. Owing to its northern latitude, Wissin also receives more sunlight during the summer than the southerly portions of the country, North Central Wisconsin enjoying an average day during the summer months of fifteen hours from sunrise to sunset, while New York City experiences only about fourteen hours, and New Orleans about thirteen hours. After the sun sets, the twilight lingers long, in the region around Lake Superior the western sky illuminating the landscape with a golden glow until 9 to 10 o'clock.

THE CLIMATIC PROVINCES OF WISCONSIN

Based upon the factors of latitude, altitude and lake influence, chiefly as affecting temperature and the length of the growing season, Wisconsin may be divided into eight climatic sections.

1. The Superior Shore. A narrow belt adjoining Lake Superior, of unknown width, though it is unlikely that the lake influence extends further inland than twenty-five miles, and apparently, as a factor of horticultural value, it does not exceed five miles. There also appear to be great variations within this belt, the southeastern slope at Bayfield being warmer and having a growing season much longer than the northwestern slope at Herbster. The Herbster record is so short, however, as to be of little value. This Superior shore is characterized by cool summers, with frequent northeast winds off the lake and a mean temperature (64°) like that of the coast of Maine or the Puget Sound region; pleasant, prolonged autumns, (46°) similar to those of the Berkshire Hills of Massachusetts, or eastern Washington; cold, continuous winters, having about the same mean temperature (15°) as the central portion of Wisconsin, Aroostook county Maine, the Green Mountains of Vermont, southern Minnesota, or northern Montana; and cool, retarded springs (37°) resembling the Adirondacks and the Red River Valley.

Generally, on about four winter mornings, the temperature drops to 20° below zero or lower; while on an average of five days in summer it reaches 90° or more. Sudden changes in temperature occur in this section, due to shifts in the direction of the wind. In summer, a storm coming up the Mississippi Valley causes a hot, dry wind from the south, which descending 1000 feet from the highlands is further heated by the increased pressure, and often sweeps down upon the lake shore with marked severity. The temperature may rise to over 100°, and then with the passing of the storm center to the east, a reverse breeze off the lake sets in, reducing the temperature even below 50°, and usually accompanied by rain, In winter reverse effects follow this change in wind, the land breeze being cold and the lake breeze comparatively warm.

The average length of the growing season varies from probably 150 days on the Apostle Islands, Madeline being the warmest, to an average of 130 days on the mainland near the water, diminishing probably to 115 days ten miles inland. However, the records in this region are so few and short that estimates of the length of the growing season are merely approximate. The islands, therefore, have a growing season similar to that of the St. Lawrence Valley, northern Iowa, or eastern Colorado, but a much colder summer temperature (about 60°), while a belt ten miles inland, though it has a shorter growing season, similar to that of Central Maine, the Catskills, Central North Dakota, or Montana, has a mean summer temperature probably 5° warmer than the islands.

The rainfall on this northern slope, owing to the lessened evaporation and the fact that a larger proportion comes in summer and fall, is probably more effective than in the southern part of the state; but the occasional cold, wet, windy northeasters, lasting sometimes a couple of days, are very disagreeable. On the whole, this region resembles the coast of Maine in both climate and scenery, though clear and free from fogs in summer, colder and drier in winter, and covered with a deep blanket of snow from December 1 to April 1.

The relation of climate to fruit growing in this region is discussed in a later section of this bulletin.

2. *The Northern Highland.* A large area covering most of the state north of Marathon county, and including the headwaters of the Wolf, the Wisconsin, and the Chippewa rivers, together with the smaller streams flowing into Lakes Superior and Michigan. This region is characterized by a short growing season, cold winters, warm summer days, and cool summer nights. The mean winter temperature (13°) and also spring temperature (40°), is like that of the Adirondacks, or eastern Montana; while the mean summer (65°) and fall (45°) temperatures are equal to those of Vermont and North Dakota, differing from Vermont, however, in frequent hot spells when the thermometer may reach 90° and rarely 100°. In the western portion, the thermometer reaches 90° or above on an average of fifteen days each summer, while on about ten mornings during the winter it drops to 20° below zero; but

in the eastern section on only about five days in the year does it rise above 90° or fall lower than 20° below zero.

The northeastern portion is cooler than the southern and western, the growing season averaging about eighty days in Vilas county, as compared with 130 days in Marathon and 120 days in Burnett county. This northeastern region thus resembles northern New England, nearly all the Rocky Mountain region, and eastern Oregon in length of season. Near the small lakes which abound in this portion of the state, the growing season is apparently lengthened thirty to fifty days, however, the short records at Minocqua, Rhinelander, and Lac de Flambeau showing an average of 130 days; while those at Crandon, Prentice, Eagle River, and Vaudesare, average only seventy-seven days. Away from these lakes, in these five northeastern counties, light frosts are likely to occur upon low land in any month of the year.

The northern highland possesses, perhaps, the heaviest rainfall of the state, though having the least number of rainy days, and the most sunshine. The monthly distribution of the precipitation is shown in Figure 16.

In general, the climate of this section of northern Wisconsin resembles that of northern New York, each of the four seasons averaging probably 2° cooler, the Adirondacks being represented by the Iron ranges, Lake Ontario being replaced by Lake Michigan, the St. Lawrence Valley by the Superior basin, and the Champlain basin by the St. Croix valley.[2]

3. *The Mississippi Valley.* This is a rather deep depression, the warm influence of the lower altitude being apparent from Dubuque to Grantsburg. This narrow valley is the warmest portion of the state, and is characterized by hot summers and much cooler and drier winters than the Michigan shore. The mean summer temperature averages about 71° and is similar to that of New Jersey and southeastern Pennsylvania, Ohio, or southern California.

The mean winter temperature in the southern portion of the valley (21°) is about the same as that of southern New Hampshire, eastern New York, central Michigan, or northern

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[2] The climatic data for the northern portion of the state are as yet too meagre and many of the records too short to warrant final conclusions. The Weather Bureau Service in this region has been greatly improved, however, in the past few years, and before long a valuable accumulation of facts will be available.

Nebraska, while the northern portion of the valley averages 5° colder, resembling the winter climate of northern Vermont, northern Michigan, or eastern Montana. On an average of seven days during the winter the thermometer drops to 10° below zero or lower; while during several summer afternoons a temperature of 95° may be expected. The growing season in this valley ranges in general from 150 to 175 days, about the same duration as the Hudson River Valley, nearly all of Ohio, the northern half of Illinois, western Kansas, or the Columbia River Valley. The average rainfall varies from 30 inches to 33 inches, the heavier precipitation falling upon the hill lands along the eastern margin of the valley. The monthly distribution of rainfall is shown in Figure 16.

4. *The Southern Highlands.* This possibly new term is used to include the rough to rolling region, generally over 1000 feet in elevation extending from Clark county south to the Illinois line and lying between the Mississippi Valley on the west and the Wisconsin and Rock River Valleys on the east. It is characterized by a cooler temperature than the adjoining valleys, the summer temperature (66° to 69°) being similar to that along the Michigan shore, while the mean winter temperature is only about 2° higher than along the Superior shore. The growing season, averaging 145 days, is apparently twenty to thirty days shorter than the lower lands of the state in the same latitude, while in the river valleys and ravines in this section, the frost danger is still greater, the combined records at Darlington and Gratiot averaging only 120 days. Corn in exceptional years fails to mature, while grass and hay are the dominant crops. The use of land for pasturage is also encouraged by the topography and the heavier rainfall (averaging 34 inches).

5. *The Wisconsin River Basin.* This also appears to be cooler than the Mississippi Valley to the west, or the Michigan shore to the east, being cooler (68°) than the former (70°) in summer, and cooler (16°) than the latter (21°) in winter. This region averages about thirteen days in winter when the temperature drops lower than 10° below zero, and 13 days in summer when the thermometer rises above 90°. The growing season is also considerably shorter, owing probably to the altitude, the sandy soil, and the marshy condition of much of the land, Mauston having an average season of

130 days from frost to frost, as compared with 163 days at La Crosse to the west, and 149 at Oshkosh, or 167 at Sheboygan to the east. Likewise, Stevens Point has an average growing season of 126 days, which is 33 days less than Green Bay and 35 days less than Wabasha or Red Wing in the Mississippi Valley.

This short growing season, as well as the sandy soil, aids in explaining the small amount of corn raised in this region and the extensive development of the potato industry. The rainfall, 29.5 inches, is probably a little less than the average for the state, and has a seasonal distribution similar to that for the whole state as shown in Figure 16.

6. *The Fox and Wolf River Basins.* These possess an intermediate climate, partaking some of the influence of the lake but exhibiting more of the features of a land climate. The winters at Green Bay, Appleton, Pine River, Oshkosh, and Fond du Lac, with a mean temperature averaging 18.7°, are as warm as those at Dodgeville or at Lancaster, while the springs (43°) and the summers (68°) are as cool as the average of Eau Claire and Osceola. The growing season of 130 to 150 days, however, shows the land influence, being of about the same length as Richland, Buffalo, and St. Croix counties, Wisconsin, or Cattaraugus, Chenango, and Delaware counties, New York, Center and Lycoming counties, Pennsylvania, northern Iowa, or central Utah. The rainfall (29.6 inches) in this region is possibly a little less than elsewhere in the state.

7. *The Rock River Basin.* This section has the longest growing season in the state, averaging about 170 days, which is as long as that of central Illinois, longer than central Indiana or Ohio, and about equal to the valley of Virginia and central Maryland. The annual temperature curves also show here a northward bend and though the winters (20°) are cooler than along the lake, the springs (45°) and the summers (70°) are warmer. Hence this section is the best corn area in the state. The temperature of the Rock River basin in summer is similar to that of northern Illinois, Indiana, Ohio, and southeastern Pennsylvania, while in winter it resembles southern Vermont, northern Iowa, or southern Montana. During seven summer days, on the average, the thermometer may go as high as 90° and during five winter mornings fall to 10° be-

low zero or lower. The average rainfall ranges from 31 inches at Madison to 35 inches at Brodhead, and is distributed as shown in Figure 16, diagram Southern Wisconsin.

8. The' Michigan Shore. This section possesses the most equable climate in Wisconsin. The winters are mild, (22°) and somewhat moister than elsewhere in the state, resembling those of the coast of Maine, or eastern Michigan; the springs (42°) are retarded and cool, like those along the coasts of New England and British Columbia; the summers (67°) are mild and pleasant, averaging over 2° cooler than the Wisconsin or Rock River valleys and 4° cooler than the Mississippi Valley; while the autumns (50°) are warmer than further west, the temperature being about the same as that of eastern Massachusetts, the Hudson Valley, or the Lake Ontario shore of New York. During the winters an average of five days shows a temperature lower than 10° below zero, while on seven days in the year the thermometer registers 90° or more. The lake shore is not a distinctive corn region, but is splendid for pasture, peas, and hay, the growing season extending from about May 1 to October 10, thus resembling southern Ontario and northwestern New York. The average rainfall (30.3 inches) is slightly less than that of the state in general, and a larger proportion is precipitated in winter (5.2 inches), and less in summer (9.6 inches). The average monthly distribution of rainfall for the Michigan shore stations is shown in Figure 16.

PART III. AGRICULTURE AND CLIMATE

CLIMATE AND FIELD CROPS IN WISCONSIN

Wisconsin is located along the northern limit of the region adapted to corn. The climatic limit of corn growing is not determined solely by the length of the period between killing frosts in the spring, and in the fall, but depends also on the seasonal temperature, which is shown in Figures 6 and 8, especially on the temperature of the nights. While it is true that some of the earliest varieties of corn may be matured in 100 to 110 days provided the temperature during this time is suitable, it is also true that if the weather during this period is not sufficiently warm and there are many cool nights in the latter part of the season, corn may not mature in 120 to 130 days. The date of planting corn is remarkably uniform throughout Wisconsin, being commonly between May 10 and May 20.

There is practically no high land in the state of Wisconsin where the average growing period between killing frosts is not of sufficient length to permit the growth of at least early varieties of corn, and probably three years out of four, such varieties can be grown on land having proper location throughout the northern part of the state. Cold waves are likely to occur following the cyclonic storms; and at the time of these cool waves, frost is very likely to form on all land so situated that the cold air collects on it. This applies to the lower slopes, especially to hollows, and also to areas protected from the air movement by forest belts. It is only on comparatively high land from which there is opportunity for the cold air to move as formed, that freedom from frost throughout the summer permits the growth of corn in areas of the northern portion, and especially the northeastern portion of the state. While marsh land, when properly drained and fertilized, is well adapted to corn in the southern part of the state, it is not suitable in the northern part of the state for this crop, or for potatoes, or other crops at all subject to frost. Its best use is probably for the growing of hay for winter forage.

The sugar beet is another plant dependent to a considerable extent on climatic conditions. Cool, clear weather, particularly during the ripening period is especially favorable to a large sugar content, and since these conditions prevail very generally through a large part of Wisconsin, especially in the northern portion, this crop is well adapted to the state where suitable soil conditions exist. It should be recognized, however, that sugar beets require a large amount of hand labor and should be grown only on soil in a very fertile condition and having a large supply of available moisture.

Small grains are also influenced materially by the character of the climate. Since their growth takes place during the spring and early summer months, they are adapted to a climate in which there are proper moisture conditions during that period. These, in general, obtain in this state, especially in the northern portion. During their ripening, the starch which is largely formed in the leaf and stem of the plant is transferred to the seed, and the best ripening of these crops requires cool and preferably rather dry weather during this stage. For this reason, most of the small grains grown in the northern states are heavier than where grown in the southern states. This is particularly true of oats. Although this crop is sown nearly a month earlier along the southern boundary of the state than in the extreme northern part, the difference in harvest time is reduced to three weeks or less, as shown in Figures 20 and 21. Wheat is greatly influenced by the climatic conditions which obtain, especially during the ripening period. The comparatively dry atmosphere of Wisconsin tends to develop hard wheat as compared with the softer wheat which develops in more moist climates. The large yields of barley of excellent quality have for years shown that Wisconsin's climate is also well adapted to this cereal.

Grains, grasses, and clovers as grown for seed in northern states are well known to have a high degree of vitality and this is probably connected with the influence of conditions on maturing of the seed as mentioned above. Undoubtedly one of northern Wisconsin's greatest assets is the suitability of her climate to the production of high class seed of the cereals, grasses, and clovers.

Although the rainfall of Wisconsin is not sufficient in quantity or so evenly distributed as to secure the most perfect pasture conditions possible, nevertheless the suitability of much of its soil to the grasses is such that the state does as a matter of fact have very good pasturage. An occasional drought from two to four weeks long seriously lessens the value of pastures, but this contingency can be met by the use of silage kept over from the previous year.

From 3,000,000 to 5,000,000 acres of Wisconsin soils are sandy loam well adapted to potatoes and it is therefore fortunate that the climatic conditions of the state are so favorable to this crop. The good distribution of rain in July and August and the usual summer temperatures promote vigorous growth, while the drier autumns afford favorable harvesting weather.

Peas are extensively grown in those portions of the state having cool summers and limestone soils, such as the Lake Michigan shore and northwestern Wisconsin; while beans are produced mainly in the warmer south central area of sandy loams.

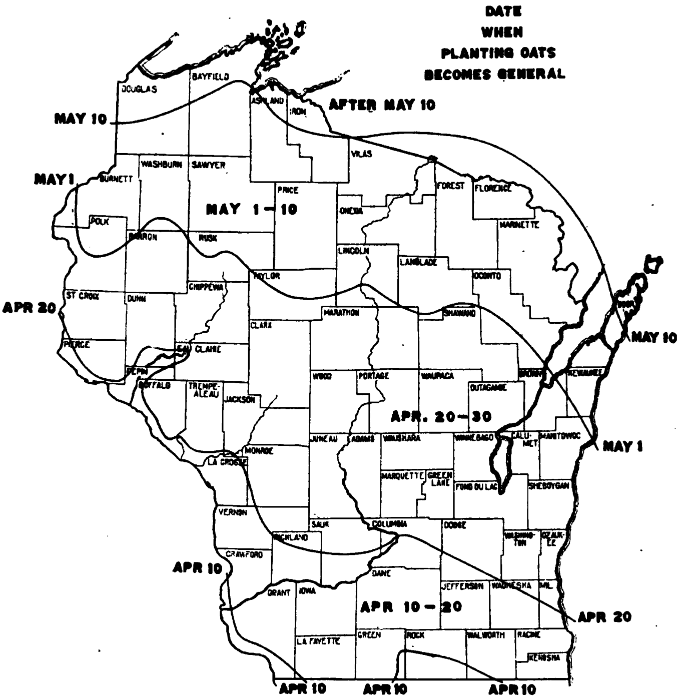

FIGURE 20. TIME OF SOWING OATS

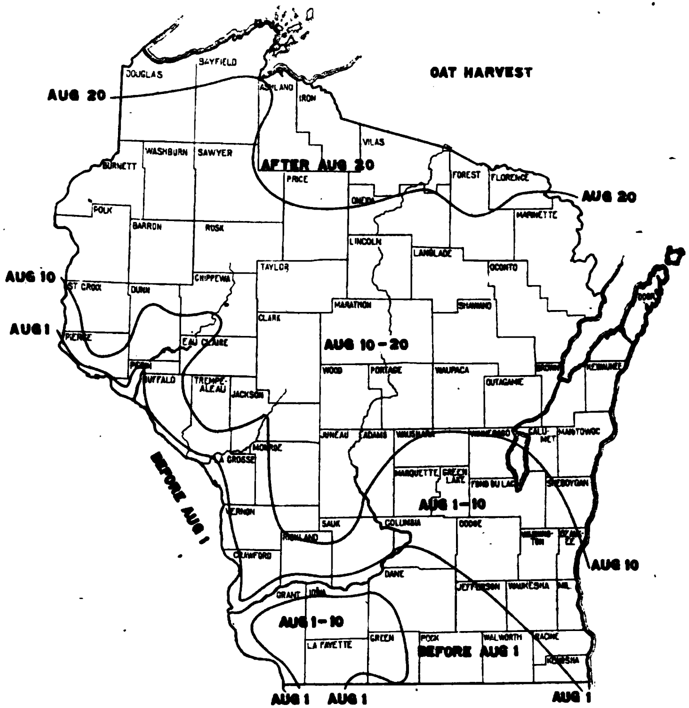

FIGURE 21. TIME OF HARVESTING OATS

These crop planting and harvesting maps are based mainly on records collected by J. R. Covert of the Bureau of Statistics, U. S. Department of Agriculture, supplemented by similar records gathered by H. A. Miller, Office of Farm Management, U. S. Department of Agriculture, labor records supplied by Prof. H. C. Taylor from the farms cooperating with the Office of Farm Management and the College of Agriculture, and reports from farmers and state experimental farms received by the authors. Records from 200 localities in all.

Wisconsin ranks sixth among the states in tobacco production, growing more than any other northern state. Half of the Wisconsin crop is raised in the eastern portion of Dane county, this district extending into Rock county on the south and Columbia on the north; while a secondary center occurs in Vernon county and up the Mississippi Valley. Both of these areas have a mean summer temperature of nearly 70°, which Figure 7 shows exists also in eastern Kentucky and southeastern Pennsylvania, other noted tobacco regions. These Wisconsin districts constitute the most northerly tobacco growing regions in the United States. The development of the industry is undoubtedly due in part to social and soil conditions, yet the limitation of commercial production to those sections of the state which possess a long growing season and high summer temperature indicates that the climatic conditions have also been influential.

CLIMATE AND THE DAIRY INDUSTRY

The remarkable development of the dairy industry in Wisconsin is unquestionably due to a considerable extent to climatic conditions. Wisconsin now has more dairy cows and produces more milk than any other state in the Union.[3] The growth of this leading industry, with an annual production valued at $80,000,000 in 1909, and involving 1928 cheese factories, 1057 creameries, and 19 condensed milk plants, has been steady and rapid.[4] As a whole, dairying can be called a combined agricultural and manufacturing industry. The agricultural side consists in growing crops for feed. The manufacturing side consists in the transformation of this feed through the dairy cow and the factory into butter and cheese. While the growth of crops is limited to the summer period, the manufacturing phase of the industry may be continued throughout the year. In this way the rural population engaged in the dairying industry find profitable employment throughout the year in a way that would be practically impossible in such a climate as ours if only the production of crops was undertaken. Moreover, the cool temperature and the character of the precipitation produce pasturage which reduces the agricultural work of the summer so far as the feeding of the cattle is concerned, and makes possible the production of a quality of dairy products, especially of cheese, which is not readily obtained in warmer climates. In these ways climate largely controls the dairy industry.

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[3] Wisconsin had 1,471,591 dairy cows on April 15, 1910, ranking second among the dairy cow states of the Union, New York being first with 1,509,672; but while there was almost no increase in the number of dairy cows in New York in the decade from 1900 to 1910, there was an increase of 50% in the number of dairy cows in Wisconsin. If this same rate of increase has obtained in both states since April 15, 1910, Wisconsin is now clearly in the lead.

[4] Rpt. State Dairy and Food Commissioner (1910) p. 4.

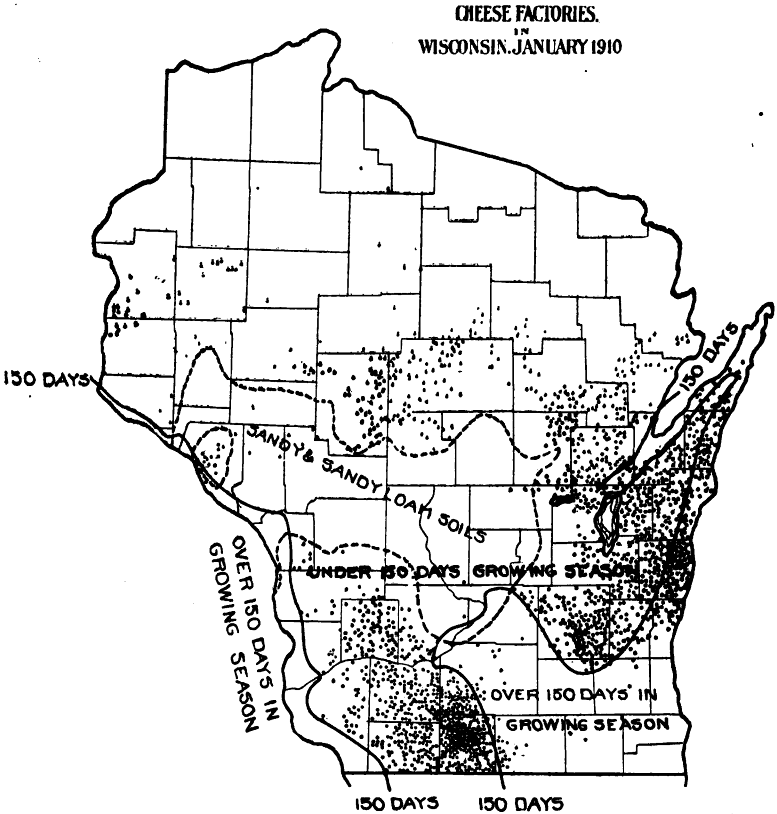

FIGURE 22. RELATION OF CHEESE DISTRICTS AND GROWING SEASON

Cheese production has developed in those portions of the state having less than 150 days in the growing season.

It will be noted in Figure 22, showing the location of the cheese factories of the state in 1909, that the industry is virtually concentrated at present into two well defined large districts in southwestern and in eastern Wisconsin, and two smaller centers in the north central and northwestern portions of the state. The butter industry, on the other hand, as shown by Figure 23, occupies southeastern Wisconsin with equal exclusiveness, sweeping northward as far as Burnett county and dominating the whole Mississippi slope, excepting the first cheese region above mentioned. The creamery district also extends an arm northward from Columbia county through Green Lake and Waupaca counties as far as Langlade county.

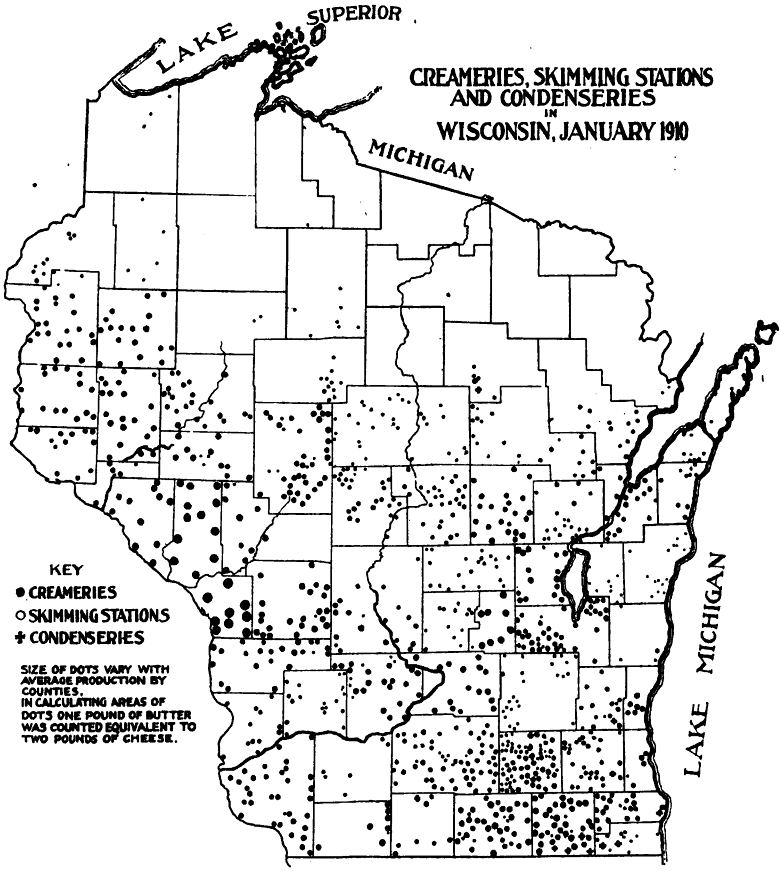
LAKE SUPERIOR
CREAMERIES, SKIMMING STATIONS AND CONDENSERIES IN WISCONSIN, JANUARY 1910
MICHIGAN
KEY
● CREAMERIES
○ SKIMMING STATIONS
✚ CONDENSERIES
SIZE OF DOTS VARY WITH AVERAGE PRODUCTION BY COUNTIES.
IN CALCULATING AREAS OF DOTS ONE POUND OF BUTTER WAS COUNTED EQUIVALENT TO TWO POUNDS OF CHEESE.
LAKE MICHIGAN

FIGURE 23. CREAMERIES, SKIMMING STATIONS, AND CONDENSERIES
This shows their concentration in the corn producing sections of Wisconsin in 1909.

Comparing these dairy maps with the climatic maps we note the following relationship: The present commercial production of cheese in Wisconsin is bounded on the south with approximate accuracy by the line of 150 days in the average growing season, except along the Michigan shore, where, although the growing season is long, the temperature is cool. The few cheese factories lying to the south and east of this line are small and struggling. This growing season line of 150 days also bounds the cheese district of New York.

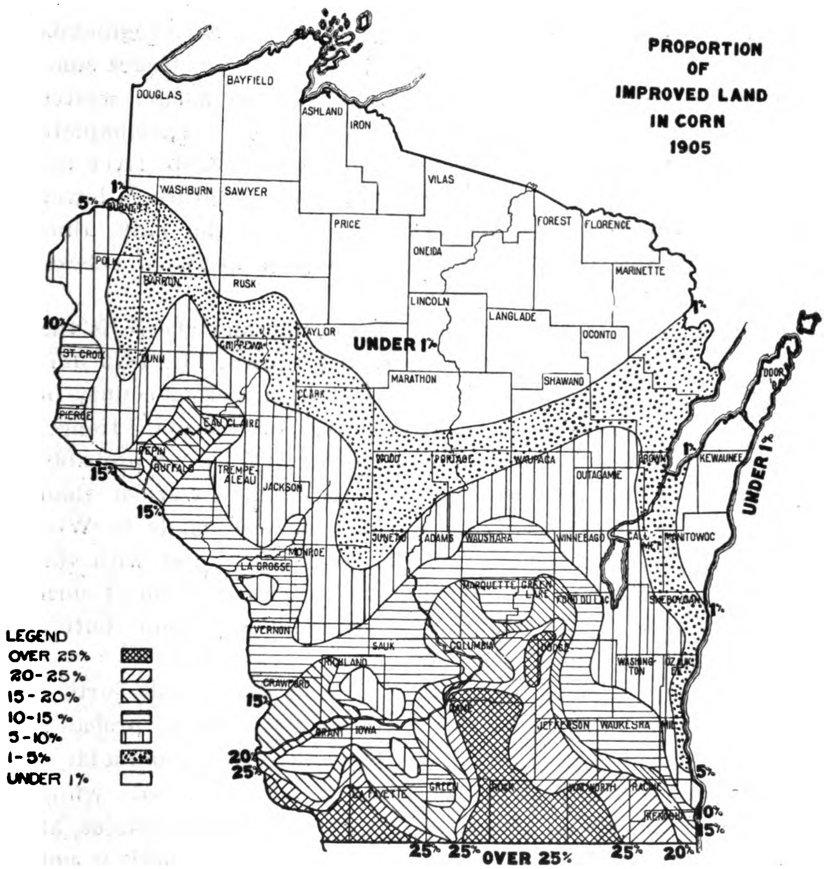

FIGURE 24. WISCONSIN'S CORN AREAS

This map is based on the state census statistics for 1905. The very small amount grown at that time in northern Wisconsin is due not alone to climatic limitations, but also to pioneer conditions. Flint corn is now grown throughout northern Wisconsin, and certain varietes of dent corn have matured in Florence, Oneida, and Ashland counties about two years out of three.

South of the mean summer isotherm of 70° there are no cheese factories in Wisconsin, and those between the isotherm of 69° and 70° are not numerous and mostly small. The mean isotherm of 65° for the cheese making season (May to September inclusive) approximately bounds on the south the cheese regions of the state.

The corn production map, Figure 24, when compared with

Figure 6, shows that north of this summer isotherm of 69°, corn is not the dominant crop, since it sometimes fails to mature before frost; but instead, a grass land map, which approximately complements the corn map, shows that grass is more extensively grown, two-thirds to four-fifths of the improved land in northern Wisconsin and the southern highlands being in pasture or meadow. The pasturage encourages summer dairying and cheese production, just as silage, winter dairying, buttermaking, skim milk, hogs, and corn complete the economic cycle in the Rock river and Mississippi river basins. North of this line, moreover, the temperature is lower with a resultant lower bacterial content of the milk, thus making possible the production of a higher grade of cheese, at a consequently higher price.

This division of territory between butter and cheese is the result of a prolonged struggle still in progress. In 1875 Jefferson county produced more cheese than any other county in the state, while today it leads in butter production. Hence, we must conclude that cheese of good quality, except probably Swiss cheese, can be made in regions slightly warmer than those described above (though none has been made in Wisconsin south of the summer isotherm of 70°); but with the increased demand for butter, the northward extension of corn growing, and the development of the small separator, butter became more profitable.

Within the cheese industry itself there has been a still further division of territory. In the southwestern district, probably three-fourths of the Swiss cheese of the United States and a large proportion of the Limburger cheese is manufactured; while nearly all the Swiss cheese factories make brick cheese at the beginning and close of each season when the milk is not uniform enough to make good Swiss cheese. Swiss cheese also demands a long, carefully controlled curing period, while the Limburger is a soft cheese quickly placed upon the market. Swiss cheese is perhaps the most difficult to make of the four varieties manufactured in the state.

Surrounding this Swiss cheese section, mainly upon the west and north, is a belt of factories making American cheese, which appears to be a little less particular than Swiss cheese with regard to soil and climate. About 95% of the 275 factories making Swiss cheese in this district (and only one small factory in the state outside of this district made Swiss cheese in 1909) were located on high limestone lands, very few below 900 feet elevation along the eastern margin of the district, and 1000 feet elevation along the western slope. On the other hand, 72 out of the 106 Limburger factories in the region in 1909 were located in the low, sandy, warmer lands of the Sugar River bottoms.

Table VII summarizes the temperature conditions which have influenced this division of territory.

TABLE VII. RELATION OF TEMPERATURE TO DAIRYING

Station	Average growing season in days	Mean summer temp.	Mean summer daily maximum	Mean summer daily minimum	Mean season temp.
Southwestern Cheese District		°	°	°	°
Swiss Highlands Mt Horeb	143	68.8	79.7	57.5	64.7
Darlington	124	68.7	81.2	56.2	65.1
American Belt Shullsburg	149	68.8	79.3	57.7	64.8
Dodgeville	144	69.0	80.9	57.1	64.7
Hillsboro	127	67.3	80.7	53.8	63.5
Average for region	136	68.4	80.4	56.4	64.5
Southeastern Butter District					
Beloit	166	70.5	82.0	60.0	67.0
Delavan	166	69.9	82.3	57.5	66.3
Lake Mills	153	69.1	81.0	58.0	66.0
Waukesha	163	68.7	79.1	58.4	65.1
Madison	175	69.9	79.0	61.0	66.0
Average for region	165	69.8	80.7	59.7	66.1
Eastern Cheese District					
Burnett	142	67.1	77.9	55.7	63.4
Chilton	143	67.6	79.5	56.3	64.2
Manitowoc	169	65.5	75.0	54.0	61.0
Green Bay	153	67.8	78.0	58.0	64.0
Shawano	135	67.0	79.3	54.5	62.7
Average for region	148	67.0	77.9	55.7	63.1
Western Butter District					
Dubuque	175	71.7	82.0	62.0	68.0
Prairie du Chien	168	71.5	85.2	57.9	68.0
La Crosse	171	70.1	80.0	61.0	67.0
Whitehall	126	68.4	81.8	55.0	65.0
Eau Claire	141	69.4	80.0	57.0	65.0
Average for region	157	70.2	81.8	58.6	66.5
Northern Mixed Dairy District					
Neillsville	126	68.0	81.0	55.0	64.0
Wausau	131	66.5	77.9	55.0	63.0
Medford	120	65.8	81.0	51.0	62.0
Barron	119	65.8	80.0	52.0	62.0
Grantsburg	126	66.5	81.0	53.0	63.0
Average for region	124	66.5	80.2	53.2	62.8

The growing season, it will be noted, averages 142 days for the two cheese districts, and 161 days for the two creamery regions. The mean summer temperature in the cheese districts averages 67.7°, while for the creamery regions the corresponding temperature is 70°. This difference is greater between the nightly minimums, 56° for the cheese and 59.2° for the butter regions, than between the afternoon maximums, which average 80.1° for the cheese districts and 81.3° for the creamery regions. The mean season temperature, May to September inclusive, averages 63.8° for the cheese districts, and 66.4° for the creamery regions.

It should be noted, further, that only one station in the creamery regions possesses as low a mean summer temperature as the warmest station in the cheese districts, namely, Whitehall, in the neighborhood of which, indeed, cheese is now manufactured. Only two stations in the creamery regions, Whitehall and Waukesha, both bordering on the cheese districts, show a mean summer temperature below 69°, while only one station in the cheese districts has as high a mean summer temperature as 69°. Thus the mean summer isotherm of 69°, or the season isotherm of 65°, separates the creamery from the cheese districts in Wisconsin.

The somewhat greater precipitation upon the southern highlands and the moister conditions in the Michigan shore counties, by causing better pasturage, also probably favored the development of the cheese industry in these regions.

Undoubtedly all northern Wisconsin is climatically well adapted to the production of cheese, but for the present at least, the local market for butter is so strong as to make it a successful competitor.

Several other factors, as indicated, have contributed to this geographical differentiation of the dairy industry in Wisconsin, topography, soil, and social conditions in particular, nevertheless, climatic control appears to be most powerful.

CLIMATE AND FRUIT IN WISCONSIN

The production of fruit is influenced by the character of the climate in several ways. Among the desirable climatic conditions for tree fruits are the following:

Freedom from late frost, with cool weather in the spring to retard bud development until the danger is past.

Clear and not too warm summer weather, making possible the development of good color and quality.

Prolonged, cool falls, permitting the ripening of the wood.

Sufficient humidity in the atmosphere during the winter, and freedom from abnormally low temperatures, thus protecting the moisture of the tree.

These conditions are usually found in the vicinity of large bodies of water, especially on the windward side. The large lakes retard the advance of warm weather in the spring and cold weather in the fall, modify cold waves, and increase the humidity. In addition to these beneficial influences of large bodies of water, locations on hill slopes from which cold air readily drains are also desirable, since local frosts frequently occur on bottom lands into which the cold air has flowed and accumulated.

These climatic conditions are possibly best met in Wisconsin in the Door Peninsula, projecting into Lake Michigan, and the Bayfield Peninsula, together with the Apostle Islands, which project into Lake Superior. Both of these regions exhibit cool, retarded springs, mild and clear summers, prolonged autumns, and clear, steady winters with abundant snow, not so dry as to kill the fruit buds. A lake slope, protected from the wind, is preferable in these sections.

Both of these regions are now experiencing rapid horticultural development, the Door Peninsula being somewhat in advance owing to its longer settlement. The hardy varieties of apples, such as the Wealthy and Duchess, tho of slower growth than further south, color well, and possess remarkable keeping qualities; the Wealthy and similar varieties remaining in good condition until January, and sometimes until March in the Bayfield region. Crab apples also do well. The sour cherries, such as the Early Richmond and Montmorency, strawberries, and the bush fruits appear peculiarly adapted to the climatic conditions of these regions, possessing in common with all northern grown crops unusual flavor and keeping qualities.

Owing to the lateness of the season on the Bayfield Peninsula and the adjacent islands, fruit is much later in ripening, than further south and inland. The growing of small fruits for the late market is already becoming an important industry, and it can undoubtedly be very greatly extended. Strawberries of the finest color, and keeping qualities are available for shipment from two to three weeks after the crop from other districts has been exhausted.

Though these two regions possess favorable climatic conditions for fruit growing, it should not be implied that the commercial production of fruit in other sections of the state is unprofitable. Around the many small lakes, especially in the southern portion of the state, as well as along the Lake Michigan shore, fruit growing has proven profitable, and a few successful orchards are located remote from any lake protection. The hilly region of southwestern Wisconsin is a promising fruit section of the state. Strawberries and the bush fruits thrive throughout the state, the Sparta growers especially, having developed this industry to a high degree.

Let us now consider the climate of these fruit regions in more detail: the Bayfield Station, representing the Bayfield region; Sturgeon Bay, the Door county district; Milwaukee, the southern lake shore; Madison, the climatic conditions near the inland lakes of southeastern Wisconsin; and Lancaster, located in the hilly southwestern section. For comparison with other noted fruit regions the records for Hamilton, Montana (Bitter Root Valley); North Yakima, Washington; Roseburg, Oregon (Umpqua Valley); Montrose, Colorado; and Rochester, New York, are added.

Seasonal Temperatures. The mean annual temperature at Bayfield is 41° or 2° lower than Sturgeon Bay, 4° less than Milwaukee and Lancaster, and 5° less than Madison. This difference is largely accounted for by the cold winters and retarded spring weather, while August, September, and October are about as warm as in the southern part of the state as shown by Table VIII.

TABLE VIII. MEAN SEASONAL TEMPERATURES IN FRUIT DISTRICTS

Station	Winter	Spring	Summer	Fall	Ripening period Aug., Sept., and Oct	Average for year
	°	°	°	°	°	°
Bayfield	16	37	65	46	59	41
Sturgeon Bay	21	39	64	48	58	43
Milwaukee	22	43	68	50	60	45
Madison	19	45	70	50	61	46
Lancaster	18	46	70	49	61	45
Hamilton, Mont	28	45	63	46	56	46
N. Yakima, Wash	32	50	69	50	60	50
Roseburg, Ore	42	51	65	53	60	53
Montrose, Col	27	47	67	48	59	48
Rochester, N. Y	26	44	67	50	60	47

The average winter temperatures, it will be noted, are colder in Wisconsin than in the other fruit regions; the springs are backward, except at Madison and Lancaster; the summers in northern Wisconsin as warm as in the western fruit regions, and in southern Wisconsin as warm as in the East;

while the autumns are of about the same temperature throughout the various districts.

Wisconsin Winters in Relation to Fruit. Considering the winter temperatures more in detail, it should be noted that on both the Bayfield and Door Peninsulas, the winters are warmer than in the region farther south removed from the lake influence, are freer from prolonged cold snaps, and on the Door Peninsula are no colder than in the southern part of the state, while the winter temperature at Bayfield is not far different from that at Lancaster, as is shown by Table IX.

TABLE IX. WINTER TEMPERATURES IN FRUIT DISTRICTS

Station	Mean of highest daily temperatures	Mean of lowest daily temperatures	Lowest recorded temperatures	Lowest monthly mean		
				Dec.	Jan.	Feb.
	°	°	°	°	°	°
Bayfield	24	8	—33	13	7	6
Sturgeon Bay	30	14	—35	20	16	10
Milwaukee	30	16	—25	14	10	8
Madison	24	12	—29	10	4	3
Lancaster	26	8	—30	13	3	9
Hamilton, Mont	37	19	—33	25	14	24
N. Yakima, Wash	40	23	—28	24	27	30
Roseburg, Ore	48	36	—6	37	35	34
Montrose, Col	39	16	—27	21	19	25
Rochester, N. Y	33	19	—14	20	17	14

It will be noticed that both the daily maximum and minimum during winter in Wisconsin remain below freezing, while in the other regions (except western Oregon) the fruit buds are subject to alternate daily freezing and thawing temperatures during more than half the winter. Moreover, the lowest recorded temperatures at Bayfield are no lower than in the Bitter Root Valley, while Milwaukee and Madison have shown no lower temperatures than North Yakima and Montrose.

Though cold, the winters in the Bayfield region are clear and not unpleasant, the first trace of snow occurring generally about November 1, with the ground remaining continuously covered from December 1 to April 1 in the average year. These dates also apply to Door county. As a result of this excellent protective covering, the soil often remains unfrozen. The average number of days showing a minimum temperature below freezing is 170 at Bayfield, 171 at Sturgeon Bay, 127 at Milwaukee, and 138 at Madison.

Since it is dry air, more than excessive cold, which injures fruit trees in winter, the following comparisons of mean winter relative humidity are interesting, the records from the nearest stations with similar conditions being taken where the station itself did not register the relative humidity: Marquette, Mich. (Bayfield) 84%; Escanaba, Mich. (Sturgeon Bay) 88%; Milwaukee, 78%; Madison 82%; Dubuque (Lancaster) 81%; St. Paul, 80%; Kalispell, Montana, (Hamilton) 82%; North Yakima, probably about 75%; Roseburg, Oregon, 85%; Grand Junction, Colo. (Montrose) 63%. Rochester, N. Y., 78%. It will be noted from these figures that the Bayfield and Door Peninsulas show a much higher relative humidity than either the western or eastern fruit regions, except that of western Oregon.

The interior of northern Wisconsin, however, remote from the lake influence, is characterized by low winter temperatures. In general, the planting of apple orchards in that portion of the state included within the lines of a mean absolute minimum of 30° below zero, as shown in Figure 10, must be confined to the hardiest varieties. Similarly the planting of peach trees for commercial purposes cannot be recommended north of the line of 15° below zero which includes only the Lake Michigan shore in southeastern Wisconsin.[5]

Comparative freedom from sudden cold snaps in spring and fall along the lake shores is indicated by Table X.

TABLE X. SPRING AND FALL TEMPERATURES IN FRUIT DISTRICTS

	Lowest Recorded Temperature				Lowest Monthly Mean			
	Apr.	May	Sept.	Oct.	Apr.	May	Sept.	Oct.
	°	°	°	°	°	°	°	°
Bayfield	6	21	28	17	33	44	56	44
Sturgeon Bay	12	20	30	14	31	49	56	43
Milwaukee	12	25	30	15	36	48	57	36
Madison	8	23	29	12	35	52	55	38
Lancaster	11	23	20	14	42	55	56	41
Hamilton, Mont	15	18	28	11	43	50	53	43
N. Yakima, Wash	16	24	24	13	47	54	56	46
Roseburg, Ore	26	30	30	22	46	52	57	48
Montrose, Col	16	24	21	10	43	54	60	47
Rochester, N. Y	18	29	34	23	36	50	56	43

Montrose, North Yakima, and Hamilton, it will be noted, have experienced lower September temperatures than Bayfield, Sturgeon Bay, or Madison, while October temperatures are also lower in the West.

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[5] As a novelty, peaches have been grown at Bayfield and sweet cherries at Iron River.

Frosts and Fruit. The relative freedom from injurious frosts is indicated in Table XI.

TABLE XI. FROST DATES IN FRUIT DISTRICTS

Station	Average date of first killing frost	Average date of last killing frost	Average growing season in days	Date of earliest recorded killing frost	Date of latest recorded spring frost
Bayfield	Oct. 3	May 21	135	Sept. 18	June 5
Sturgeon Bay	Oct. 10	May 26	137	Oct. 1	June 10
Milwaukee	Oct. 10	Apr. 29	164	Sept. 25	May 29
Madison	Oct. 15	Apr. 23	175	Sept. 30	May 13
Lancaster	Oct. 2	May 5	150	Sept. 12	May 27
Hamilton. Mont	Sept. 24	May 12	135	Aug. 25	May 25
N. Yakima, Wash	Sept. 21	May 23	121	Sept. 6	June 14
Roseburg, Ore	Oct. 30	Apr. 15	198	Oct. 9	May 16
Montrose, Col	Oct. 2	May 16	139	Sept. 8	May 28
Rochester, N. Y	Oct. 19	May 1	171	Sept. 26	May 30

It is worthy of note that the growing season at both Bayfield and Sturgeon Bay is longer than that at North Yakima and Hamilton, and equal to that at Montrose, in fact, an August frost has occurred at Hamilton; while the season at Milwaukee and Madison is about the same as at Rochester, N. Y. However, for those sections of the state having an average growing season under 140 days, the Duchess, Wealthy, Longfield, and other fall apples are safer than the slower maturing winter varieties.

Figure 25 shows the date of full bloom of the Duchess of Oldenburg apple in 1911.

The season 1911 was probably slightly early in southern Wisconsin, the dates of blooming for the Duchess apple ranging from two to five days earlier than the average of several long records. In northern Wisconsin, however, it appears to have been normal, though the records in the northern portion of the state are too few and short to warrant any accurate conclusions.

The map is based on records from thirty-five localities collected by Prof. H. P. Gould, Pomologist, Department of Agriculture, Washington, D. C., and by the writers of this bulletin; and must be considered only roughly approximate, since, in addition to the small number of records and probable variation in personal opinion of the observer, the date of blooming of fruit trees is determined by at least five factors:

The amount of heat received during the spring up to the time of flowering.

The climatic conditions during the previous summer and fall as affecting the development of the fruit buds.

The crops of the preceding year as affecting the vigor of the trees.

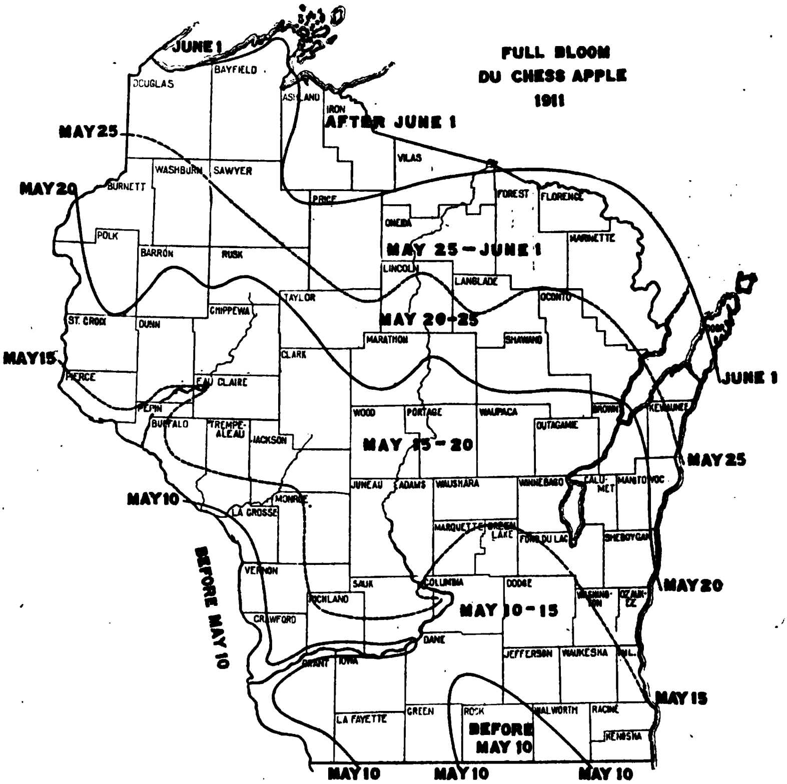

FIGURE 25. APPLE BLOOMING TIME IN WISCONSIN

This map is based upon 37 records collected by Prof. H. P. Gould, Pomologist, Bureau of Plant Industry, Washington, D. C. and by the authors.

Slope of orchard and soil fertility.

Individual characteristics and health of the tree.

A comparison of this Figure 25 with Figure 11 shows an average interval between the last killing frost in spring and the blooming of the Duchess apple, of about a week in southwestern Wisconsin (though overlapping in the ravines and valleys of the southern highlands), and of two to three weeks along the Lake Michigan shore. All northern Wisconsin, except the Superior shore, appears to possess a very narrow margin between the last killing frost and the blooming of the Duchess apple, and in places no interval, indicating that in this portion of the state, northern slopes to retard development, and excellent air drainage are essential qualifications for orchard sites. Along the Superior shore, the mean margin between frost and blooming time varies from nothing a few miles inland, where the chances of avoiding frost injury are accordingly 50%, to ten days at Bayfield and two weeks on Madeline Island. The absence of reliable frost records along the shore between Bayfield and Superior renders impossible any estimate of the interval in this prospective fruit belt.

A comparative study of several long records indicates that the Wealthy apple blooms on the average two days later, the Fameuse four days later, and the N. W. Greening six days later than the Duchess; while the Kieffer Pear averages three days earlier, the De Soto Plum four days earlier, and the Early Richmond cherry five days earlier. Keeping these figures in mind, a comparison of this map showing the average date of full bloom of the Duchess apple with Figure 11 will indicate not only the probability of frost injury to the Duchess apple in different portions of the state, but also for other varieties of fruit as well.

Further assistance is afforded in determining this danger from late spring frosts by several orchard records, especially that of Geo. J. Kellogg, of Lake Mills, who with marked patience and perseverance has accurately observed the dates of beginning of bloom, of full bloom, leafing, harvesting, etc., for some twenty varieties of fruit, as well as the frost dates and the daily temperatures, for the past ten years. We have here an indication of the limitations of fruit growing around the small lakes of southeastern Wisconsin though owing to a low location Mr. Kellogg's orchard is abnormally sensitive to frost.

During these ten years Mr. Kellogg has gathered two extra heavy apple crops, three were fair, four were half crops, and one was a total failure. Among the climatic causes, we find that the failure (1910) and two of the fair yields were in part occasioned by spring frosts, that one of the half crops was due to a severe winter, attaining a temperature of 35° below zero, with 48 days reaching zero; while the three other small yields were caused in part by wet cold springs, especially at blossoming time. Likewise, during eight years of record, there were four full crops of pears, two fair crops, and two failures; while similarly the plums show two full crops, five fair, two small, and two years of failure; and the cherries during seven years, two full crops, two fair crops, two small crops, and one total failure in the memorable season of 1910, when the freezing of all fruit was not due in reality to late frost, but to a spring fully a month earlier than usual.

At the Experiment Station orchard, at Madison, similarly located on the shore of a small lake, the injury from climatic causes has been much less, probably not occasioning loss more frequently than one year in ten, either from late frost or from severe winter temperatures. The records of two fruit growers near Baraboo, A. D. Brown and L. H. Palmer, indicate that in the hill lands of west central Wisconsin during the past five years two full apple crops, one fair, one half crop, and one failure have been experienced; and a similar five year record of Fred Willharms, of Cedarburg, Ozaukee Co., shows two full apple crops, one fair, one poor, and one failure in this Lake Michigan shore region. In general, the trees in northern Wisconsin are too young and the records too short to afford reliable figures, but Thos. W. Melville, of Chippewa Falls, reports full crops seven years out of ten, with a 75% crop in 1903 and 1905, and a failure in 1910. Such a spring as 1910, however, is not likely to occur again in twenty-five years.

The Lake Superior and Lake Michigan Shore regions, owing to the retardation caused by the cold water, appear to have escaped injury even during this extraordinary year. Fruit growers at Bayfield, Washburn, and La Pointe, Sturgeon Bay, Oshkosh, and Lake Michigan points report no injury to apples during the time covered by their records which ranges from two to ten years.

Daily Range in Temperature. It is claimed in the West that the cool nights and warm, bright days are the cause of the superior keeping quality of western fruit. Table XII shows that the Bayfield and Sturgeon Bay regions have three-fourths as great a daily range as the western districts, and exceed that of western New York.

TABLE XII. MEAN DAILY TEMPERATURES

		Mean lowest nightly temperature	Mean highest daily temperature	Mean daily range	Mean temperature	Mean temperature for 4 mo.
		°	°	°	°	°
Bayfield..........	June....	50	72	22	61	64.5
	July.....	57	79	22	68	
	Aug......	58	78	20	68	
	Sept......	50	70	20	60	
Sturgeon Bay.....	June. ...	48	70	22	59	63.0
	July.....	55	76	21	65	
	Aug......	57	77	20	67	
	Sept.....	50	71	21	61	
Milwaukee........	June.....	55	72	17	64	66.0
	July.....	62	78	16	70	
	Aug......	61	76	15	69	
	Sept......	54	70	16	61	
Madison..........	June.....	58	77	19	68	68.0
	July.....	63	82	19	72	
	Aug......	61	78	17	70	
	Sept......	54	70	16	62	
Roseburg, Ore....	June.....	49	72	23	61	63.0
	July.....	52	80	28	66	
	Aug......	53	80	27	66	
	Sept......	48	74	26	61	
N. Yakima, Wash.	June.....	49	82	33	65	66.0
	July.....	53	88	35	71	
	Aug......	52	87	35	70	
	Sept......	42	75	33	59	
Montrose, Colo....	June.....	52	83	31	66	67.0
	July. ...	58	87	29	72	
	Aug......	55	84	29	69	
	Sept......	48	77	29	62	
Rochester, N. Y..	June.....	57	76	19	66	67.0
	July.....	62	80	18	71	
	Aug......	60	78	18	69	
	Sept......	53	72	19	63	

Sunlight. The number of clear days at Bayfield is noteworthy. Table XIII shows the average number of clear, partly cloudy, and cloudy days at the following Wisconsin stations.

TABLE XIII. DAYS OF SUNSHINE IN WISCONSIN PER YEAR
Taken from records 7 to 25 years in length.

Station	Clear days	Partly cloudy	Cloudy days
Bayfield	180	100	85
Ashland	192	66	107
Sturgeon Bay	151	117	97
Milwaukee	136	102	127
Madison	123	117	125

Table XIV shows the number of clear, partly cloudy, and cloudy days in each month at Bayfield and Sturgeon Bay.

TABLE XIV. SUNSHINE AT BAYFIELD AND STURGEON BAY

Month	Bayfield			Sturgeon Bay		
	Clear	Partly cloudy	Cloudy	Clear	Partly cloudy	Cloudy
Jan...	12	8	11	14	5	12
Feb.	12	12	4	10	11	7
March	16	9	6	11	9	11
April...	17	5	8	11	9	10
May	18	7	6	11	13	7
June	19	8	3	15	10	5
July	21	8	2	15	12	4
Aug	16	10	5	13	15	3
Sept	16	10	4	16	7	7
Oct	16	7	8	15	8	8
Nov..	7	9	14	10	8	12
Dec	10	7	14	10	10	11

The remarkable number of clear days during the growing and ripening season, especially in the Bayfield region, explains in part the excellent coloring attained by the fruit in this section.

CAUTIONS FOR PROSPECTIVE FRUIT GROWERS

Owing to the short growing season remote from the water influence, the planting of orchards further inland than three miles on the Bayfield Peninsula must be regarded as an experiment; and prospective fruit growers without practical experience should also recall that fruit is not only sensitive to climatic conditions, but to such factors as soil fertility, orchard management, and prompt marketing facilities.

AVAILABLE DATA AND ACKNOWLEDGMENTS

Readers wishing climatic figures for any particular place are referred to the Climatic Summaries of the United States Weather Bureau, three sections of which are devoted to Wisconsin; Number 58 covering the northwestern portion of the state; No. 60, eastern Wisconsin, including Madison, Amherst, and Crandon; while No. 59 covers the remaining central portion of the state. These Sectional Summaries may be obtained from Prof. W. L. Moore, Weather Bureau, Washington, D. C.; and include full records of the precipitation by months for sixty-two stations scattered throughout the state up to and including the year 1909. The temperature data are less complete, but include the mean annual temperature, the absolute maximum and minimum, and the average number of rainy days, by months, for 59 stations, and also the average dates of the first and last frost. Bulletin Q of the Weather Bureau, the Annual Summaries of the Wisconsin Section, the Reports of the Chief of the Weather Bureau, and the monthly reports for the Upper Mississippi Valley, and for the Great Lakes Region afford data for about twenty additional short record stations, as well as the daily maximum and minimum, the snow fall, the condition of the sky, and the wind directions at all stations of the state; while other information may be secured upon application to the Section Director of the Weather Bureau at Milwaukee, Wis. For advice as to the varieties of corn, small grains, and fruits best adapted to different portions of Wisconsin, the reader should address the Director of the Agricultural Experiment Station, Madison.

In conclusion, the writers wish to acknowledge their indebtedness to H. P. Gould, J. R. Covert, and H. A. Miller, of the United States Department of Agriculture, for the valuable data used in the construction of the phenological maps; and to W. C. Devereaux, the former Local Forecaster of the Weather Bureau at Milwaukee; H. B. Hersey, the District Inspector; M. E. Blystone, the present Local Forecaster; and W. R. Borman, Local Observer, for permission to consult the original monthly reports of the various stations in the state, and for cordial assistance in the investigation, especially for advice as to the relative reliabilty of the records. They are also indebted to P. C. Day, of the U. S. Weather Bureau, and to E. R. Miller, H. C. Taylor, J. G. Moore, and E. J. Delwiche, of the University of Wisconsin, both for particular information and for valuable suggestions, while space forbids mention by name of the farmers, fruit growers, and other correspondents whose cooperation has added much of value to this bulletin.

The University of Wisconsin

Agricultural Experiment Station

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Walter Mulford

BULLETIN OF THE UNIVERSITY OF WISCONSIN
Serial No. 590, General Series No. 412

THE UNIVERSITY OF WISCONSIN
COLLEGE OF AGRICULTURE

HEADQUARTERS CAMP, STATE BOARD OF FORESTRY.
Headquarters of Field Instruction.

THE FOREST RANGERS' COURSE

1914

MADISON
Published by the University
November, 1913

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[1] The writer is greatly indebted to Prof. L. R. Jones of the Department of Plant Pathology of this Station for many helpful suggestions received during the progress of this study.

CALENDAR, 1914

Registration begins, Monday, January 5
Recitations begin, Tuesday, January 6
Washington's birthday, legal holiday, February 23, (February 22, Sunday)
Term at University ends, April 14
Term in field begins, April 16
Term in field ends, July 31

Work in Forest Reserve under State Board of Forestry, August 1 to October 31 or later.

FACULTY OF FOREST RANGERS' COURSE

Charles R. Van Hise, president of the University.
H. L. Russell, Dean of the College of Agriculture.
E. M. Griffith, State Forester.
*A. M. Cook, In charge of Forestry.

A. C. Burrill, Fish and Game.
L. R. Jones, In charge of Plant Pathology.
Abby L. Marlatt, In charge of Home Economics.
F. M. White, In charge of Agricultural Engineering.
J. G. Sanders, In charge of Economic Entomology and Nursery Inspection.
A. R. Whitson, In charge of Soils.
F. G. Wilson, In charge of Field Surveying.

---

*Formerly connected with United States Forestry Service as Supervisor Arapahoe National Forest, Colorado.

Entered as second-class matter, June 10, 1898, at the Post Office, at Madison, Wisconsin, under the Act of July 10, 1894.

STUDENTS MEASURING TREES.
Practical instruction is given in the field.

THE FOREST RANGERS' COURSE

The Regents of the University established a Forest Rangers' Course in the College of Agriculture for the purpose of offering elementary courses in forestry and also to give instruction to both Long, Middle and Short Course students in Agriculture, in care of woodlands and especially in the management of farm wood lots.

The practice of forestry by the owners of timber land; the organization and rapid development of definite forest policies by the states, and the organization of forest fire protective associations, are bringing about a demand for young men who have had practical training in forestry. The purpose of the Ranger School is to meet this demand by preparing men for such secondary positions as rangers, guards, tree planting experts, nursery foremen, and for responsible employment by lumber companies, commercial nurserymen, and the owners of timbered estates. Young men who have already gained some experience in general woods work and in practical lumbering operations will find this course of especial value, as they will receive training which will fit them for the more expert service which is demanded by modern methods of handling timber holdings.

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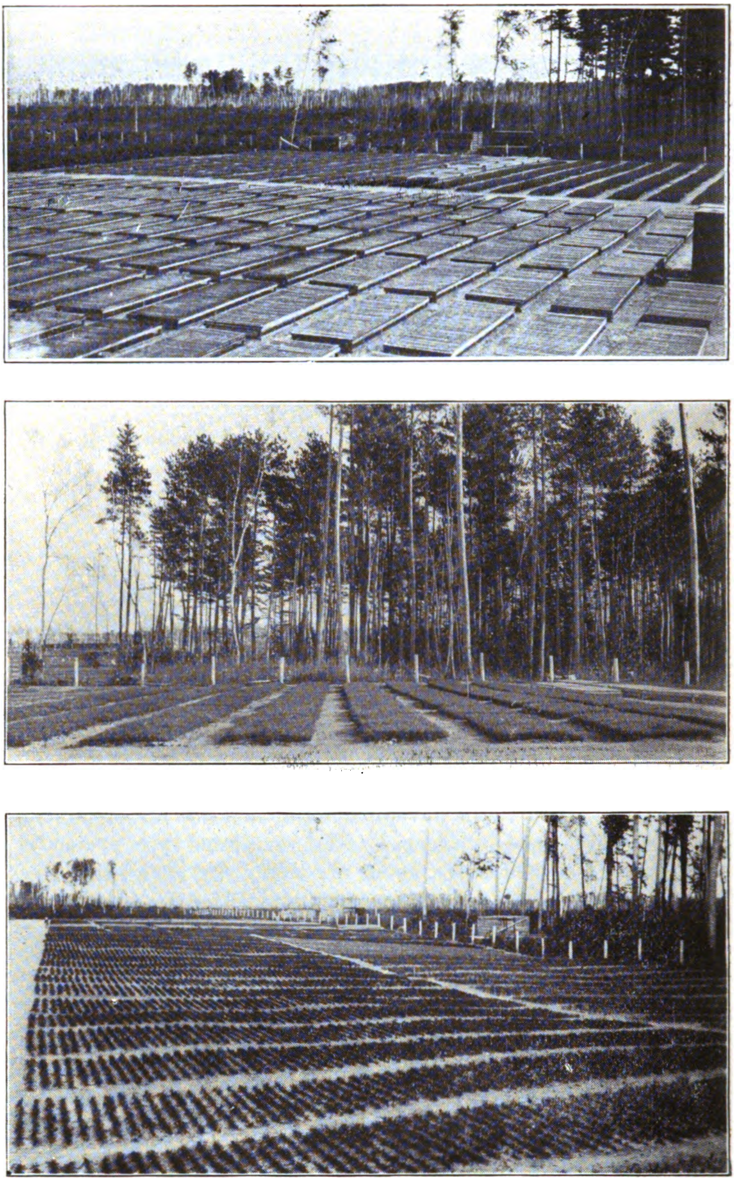
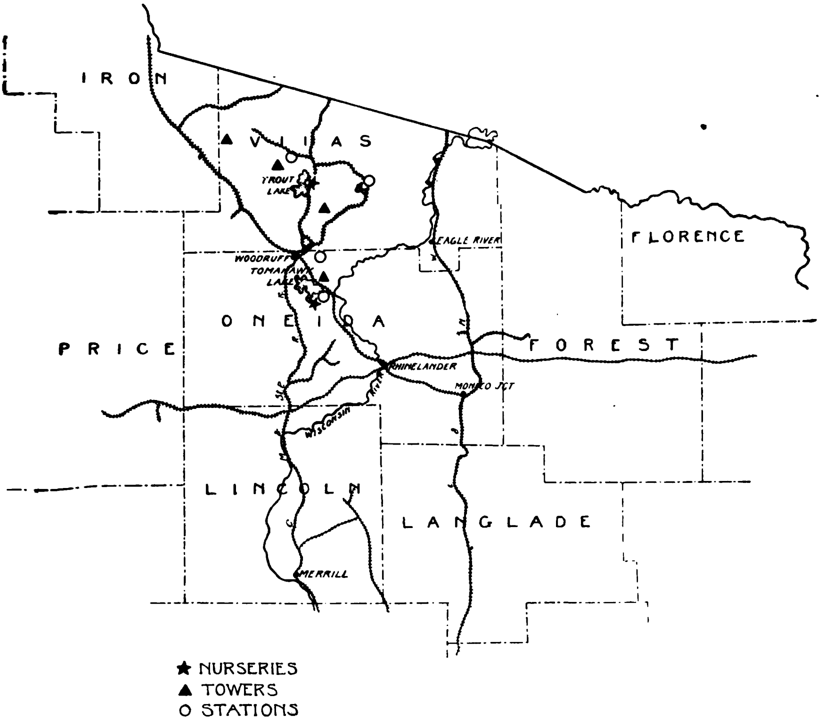


VIEWS OF STATE NURSERY AT TROUT LAKE.

Young pine must be grown in the nursery for two years before being planted. This nursery has an annual capacity of 1,000,000 seedlings and transplants.

The two years' course is not offered as a complete education in forestry. On satisfactorily completing the course, the student will not be a professional forest engineer but he should be a trained ranger or guard, or an expert in tree planting and forest nursery practice.



FOREST RANGER STATIONS

Map of Forest Reserve Region showing ranger stations, "lookout" towers and nurseries.

The life of a ranger is spent in the woods, and no one should enter the school with any misunderstanding in this respect. Students who are not physically able to do hard woods work and who do not care for the rough outdoor life, are advised not to enter the course.

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FACILITIES FOR THE COURSE.

The Ranger Course will be offered in co-operation with the State Board of Forestry, and much of the field instruction will be given on the state forest reserve. It is not expected, however, that the men trained in this work will be used exclusively in the State Forest Service.

By this cooperation with the State Board of Forestry, special facilities are offered for the student to gain practical training in forestry. A term of instruction will also be given each year at the College of Agriculture, thus providing facilities for instruction not only in forestry but also in other closely allied subjects.

Much experimental work of a very practical nature is being carried on at the United States Forest Products Laboratory located in Madison. Students of forestry will be especially interested in this experimentation and arrangements will be made to give them the opportunity to acquaint themselves first hand with the results of much of this work. Arrangements will be made for several special lectures upon vital forestry topics by the director of the Laboratory, or some of his assistants.

The state forest reserve now comprises about 400,000 acres, principally located at the headwaters of the Menominee, Wisconsin, and Chippewa rivers, in the counties of Forest, Oneida, Vilas, Iron, and Price. The reserve is divided into districts with a forest ranger or patrolman in direct charge of the field work in each district.

Forestry headquarters are maintained at Trout Lake, in Vilas County. Here is located the main forest nursery which has an annual capacity of 1,000,000 seedlings and transplants that will be planted on surrounding unoccupied cut-over pinery lands that have been badly burned over and upon which natural reproduction will not follow. Another forest nursery was started at the Tomahawk lake ranger station during the season of 1913, which will have an annual capacity of 500,000 seedlings and transplants, much of which stock will be offered for sale to residents of the state.

Comfortable houses for the rangers, with barns, wood and ice houses, etc., have already been built at the following ranger stations: Little Carr Lake, Plum Lake, Star Lake, Rest Lake Carroll Lake, and Oxley. All ranger stations are connected by telephone with the nearest town and with the forestry headquarters on Trout Lake.

LOGGING ROAD CONVERTED INTO A FIRE LINE.

An old logging road may, at a relatively low cost, be converted into a fire line for forest protection and at the same time serve as a passable highway for the ranger, settler, hunter or fisherman. More than 150 miles of such roads and 125 miles of fire line have been made in the forest reserve region.

GENERAL PLAN OF COURSE.

The Forest Rangers' Course includes work during two years, arranged according to the following plan:

(1) Work at the University from January 6, 1914, to April 14.

(2) For a period of one month beginning April 16 the students will be employed at the rate of $40 per month and maintenance by the State Board of Forestry transplanting trees on the forest reserve and doing such other work as may be necessary. It is anticipated that from 25 to 30 students will be given an opportunity for employment at this time.

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NORWAY PINE ON THE NORTH SHORE OF TROUT LAKE.

This timber is now worth over $450 per acre.

(3) From May 16 to July 31 instruction in the field will be given under the direction of the Professor of Forestry and in cooperation with the State Board of Forestry, the state forest reserve serving as a laboratory for this field work.

During the field instruction period, the student will receive board and lodging, but will be expected to devote practically one-half of his time to practical work carried on in connection with the instruction.

(4) From August 1 to October 30 or later a limited number of students will be employed in practical forestry work by, or under the direction of the State Board of Forestry. For this period they will receive, in addition to maintenance, $40 per month.

During the fall of 1914, the State Board of Forestry will be able to employ not to exceed ten or twelve students; and this number will be selected at the end of the field instruction period, the selection depending upon progress made by the students and their standing during the course.

Exceptional opportunities will be given the student to gain practical field experience in the various lines of forestry management, such as making roads, trails and fire lines, building bridges, telephone lines, and lookout towers, establishing section lines and corners, fighting fires and patrolling, burning slash, and studying tree growth and logging methods.

The nursery work will be carried on throughout the season at the Trout and Tomahawk Lake stations, and practical experience in cone collecting, seeding, care and protection of seedlings, planting, transplanting, and field planting will be an important feature of the work of the student.

LOCATION OF FIELD WORK

For the most part the field instruction will be conducted at the Headquarters Camp of the State Board of Forestry, which will be placed at the disposal of the school. This camp is in the center of the state forest reserve region, and is located at Trout Lake, which is about twelve miles north or Woodruff, Wisconsin, a station on the Lake Shore and Ashland Division of the Chicago and North-Western Railroad. The region of-

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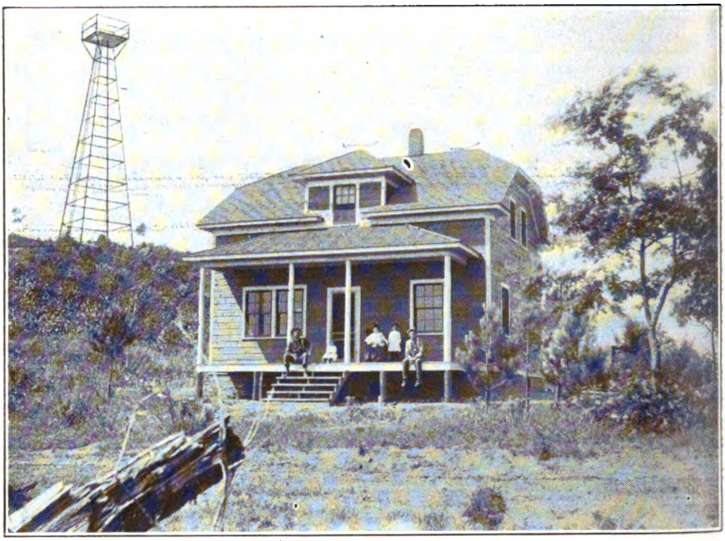
fers an exceptional opportunity for the student to study all phases of forestry, especially from the standpoint of fire protection, which is the greatest problem confronting the lumbermen and foresters of the present day. Side trips will be taken to all points of the reserve and much of the time will be spent in tents during the summer months.



RANGER CABIN WITH LOOKOUT TOWER.

By triangulation methods, the location of a fire may be quickly and accurately determined for any point within the forest reserve.

TUITION AND FEES

Tuition for residents of Wisconsin	Free
Tuition for non-residents	
First term (at University)	$7.50
Second term (in field)	7.50
Incidental fee (for all students)	
First term (at University) (including medical and gymnasium fees)	4.00
Second term (in field)	2.50

Laboratory fees (for all students)	
First term (at University)	5.00
Second term (in field)	7.50
Key and breakage deposit (balance refundable)	2.00
Other expenses	
Books, approximately	15.00
Board and room (at Madison) approximately, per month	25.00
Board and room (in field) furnished free by State Board of Forestry as compensation for practical work done.	

A list of rooms and boarding places, to aid students in securing desirable accommodations at the University, will be furnished upon application. As the University has no dormitories all students live in private homes.

Mail should be addressed to the College of Agriculture, Madison, Wisconsin, and marked "Ranger Course."

COURSES OF STUDY

First Year

Dendrology and Silviculture
Soils
Land Surveying and Mapping
History of Forestry
Meterology
Fish and Game
Camp Management
Mechanical Drawing
Forest Measurements

Second Year

Utilization
Tree diseases
Forest Entomology
Forest protection
Forest law
Forest Administration and Policy
Forest Economics

Every student will be given a thorough physical examination by the medical examiner, and will be required during the University term to take two half-hour periods per week of development exercises and athletic drill. These activities are carried on in the stock pavilion which has been equipped with facilities for this purpose, including gymnastic and athletic apparatus, lockers and shower baths.

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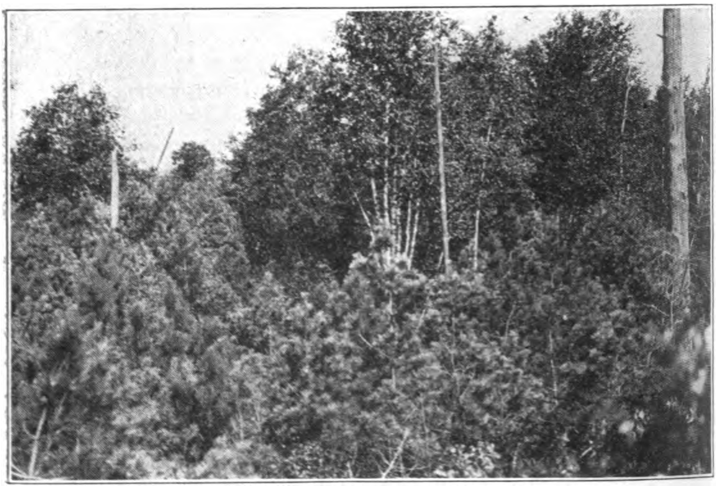
The courses in Soils, Land Surveying and Mapping, Mechanical Drawing, Entomology, Tree Diseases, and Camp Management will be given in various departments of the College of Agriculture, and all other courses in the department of Forestry.



NATURAL REPRODUCTION OF YOUNG PINE.
Where fires are kept out reproduction quickly occurs.

DESCRIPTION OF COURSES

First Year.

Dendrology (In department of Forestry). Characteristics of the important timber trees of the lake states. Forest regions of the United States, their commercial importance and distribution in Wisconsin. Detailed study of the species of trees native to Wisconsin. Field practice.

Silviculture (In department of Forestry). Relation of forests to factors of soil and climate. Factors influencing growth and distribution of trees. Seed production, time of seeding, cost of gathering seed, raising of seedlings, transplanting, field planting. Methods of handling species especially adapted for Wisconsin conditions. Field practice.

Soils (In department of Soils). Origin, classification, physical and chemical composition. Relation between forest growth and soil condition. Effects of tillage and fertilizers. Differentiation of agricultural and forest lands. Field practice.

Land Surveying and Mapping (In department of Agricultural Engineering). Land survey; Scheme of United States public land and other surveys in the United States. Problems involved in relocation of old land surveys. Methods of relocating adapted to forest work. Demarcation of forest boundaries. Use of surveying instruments, such as hand level, compass, transit, aneroid barometer; theory and practice of compass, and chain surveying. Field work will include running lines, pacing, locating and establishing section corners, field mapping.

History of Forestry (In department of Forestry). Brief history of forestry and its development in Wisconsin.

Forest Measurements (In department of Forestry). Use of various log rules. Methods of measuring logs, lumber, bark, piling, etc. Determination of rate of growth in height and diameter of trees and volume of single trees and stands. Field practice.

Meteorology (Special lectures). Weather forecasting and observation. Storm, winds, humidity.

Fish and Game (In department of Economic Entomology). Care and propagation. Habits, usefulness and protection.

Camp Management (Special courses of lectures). Camp practice and cookery, first aid to the injured, packing, care of horses. Supplies for field trips and costs of supplies and camp outfits. Lectures on hygiene and the laws of efficient living will be given by the University physician and members of the department of Physical Education.

Mechanical Drawing (In department of Agricultural Engineering). To aid the student in land surveying, mapping, and forest measurements, a practical course in mechanical drawing has been planned.

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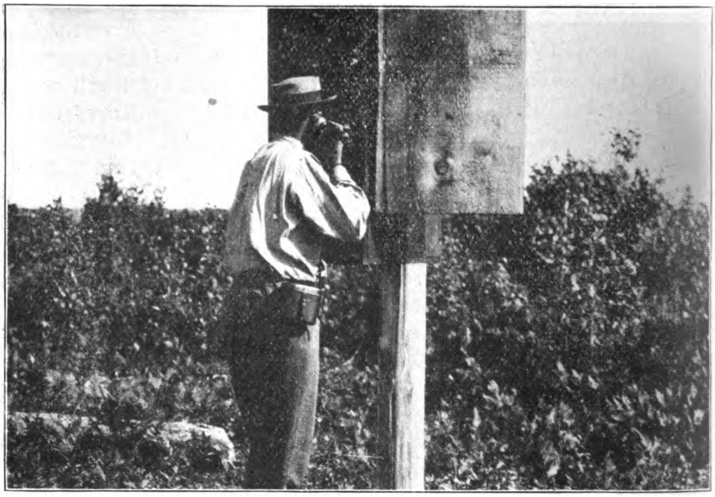
Second Year.

Timber Utilization (In department of Forestry). Logging and Milling. Methods of Manufacture of pulp, lumber, veneer, charcoal, woodenware, etc. Uses of the various wood produced within the state and points of production. Wood preservation. Logging tools and implements (costs).

Tree Diseases (In department of Plant Pathology). Diseases of the more important local timber trees and of forest nursery stock. Life history and methods of control.



THE LONG DISTANCE CALL ON THE RANGE.
Thousands of acres of timber are safeguarded by the telephone system.

Forest Entomology (In department of Economic Entomology). Description and life history of insects injurious to forest trees of the lake states region. Methods of control.

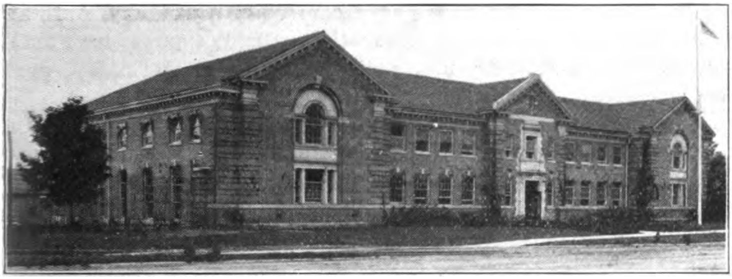
Forest Economics (In department of Forestry). The commercial importance of forests and forestry. Forest Management by the individual, by the state and by the nation. Course of a general nature and open to any student in the University.

Forest Protection (In department of Forestry). From fires, wind, insects, etc. General policy for state forest reserve.

Fire lines, purpose of, how constructed, where located, costs. Source of danger from fire, campers, fishermen, hunters, settlers, locomotives and lightning.

Telephone lines. Construction. System used—ground line, pole line, tree line. Equipment used per mile and per station, costs. Maintenance. Fire tools, cost.

Roads. Laying out, grading, building, purpose of, cost per mile. General plan of roads for reserve.



THE FOREST PRODUCTS LABORATORY.

Located near the college of agriculture and equipped and operated by the federal government.

Lookout towers. Location. Construction, steel and wood; specifications and cost. Methods of locating fires, use of maps, etc. Reports.

Ranger cabins and barns. Requirements for ranger. Methods of construction and costs.

Forest Law (Special lectures). Leases, titles, conveyances, abstracts. Federal laws and laws of states regarding fires, trespass and taxation.

Forest Administration (In department of Forestry). Organization of state service. Qualifications. General plan of development of the Forestry work in Wisconsin.

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OTHER COURSES IN AGRICULTURE

The Long Course, covering four full college years, offers scientific training in agriculture, as well as training in the underlying sciences.

The Middle Course, of two full college years, embraces essentially the work of the first two years of the Long course, but is modified to include as much practical work as possible.

The Summer Session, includes courses in Agronomy, Animal Husbandry, Agricultural Education, Field Course in Farm Management, Horticulture, Soils, Dairying, Bacteriology, and Agricultural Engineering.

The Short Course in Agriculture, two winter terms of 14 weeks each, beginning November 29, includes lectures, demonstrations, and practice work.

The Winter Dairy Course, a 12 weeks' course beginning November 5 includes lectures, laboratory and practice work in the manufacture of dairy products.

The Summer Dairy Course is a 10 weeks' training course in dairy factory operations for beginners. Students are admitted any time during the spring or summer after March 1.

The Summer Dairy Course, is a 10 weeks' training course in course of popular lectures, demonstrations and exercises in practical agricultural science, begins January 27. Open to farmers over 25 years of age. The Women's Course, a week's course of lectures and demonstrations on various phases of Home Economics—cooking, nursing, etc., is given during the Farmers' Course. The Young People's Course is a one-week course of lectures and demonstrations on agriculture for boys and girls who have participated in the Young People's Grain Growing Contests. The Special Dairy Course for creamery and cheese factory operators and managers covers 10 days at the time of the Farmers' Course.

For details concerning the Forest Rangers' Course or any of the courses included above address the Agricultural College.

The Control of Damping-Off In Plant Beds[1]

JAMES JOHNSON

INTRODUCTION

The widespread occurrence and economic importance of soil organisms is at present becoming fully recognized. How to treat the soil in such a way as to destroy the undesirable soil organisms without injuring the productivity of the soil has become one of the great problems of the science of agriculture. The subject is complicated by the fact that, in addition to the harmful organisms, the soil contains a number of organisms which are desirable and frequently essential to the permanent productivity of soils. Most soils harbor fungi, insects, bacteria, and other lower forms of living organisms which are injurious to one plant or another. Many of these pests are obligate parasites and occur only where the host plant has been previously grown. In such cases crop rotation is, in most cases, a long but sure remedy. Some of the organisms, however, including the common damping-off fungi, are peculiar in that they are parasitic upon a wide range of hosts, besides being capable of existing saphrophytically upon the vegetable matter in the soil. Crop rotation is hence practically valueless as a remedy against these fungi.

The most noticeable occurrence of the damping-off disease is in plant beds and forcing houses, where large numbers of plants are grown closely together. The amount of injury arising from this intensive system of plant culture requires a rapid and efficient means for the control of the disease. The last two decades have witnessed the recommendation of a number of methods for the control of damping-off, many of which are reported in popular literature. The purpose of the experiments described in this paper has been largely to compare these methods. The work on this disease was at the outset primarily conducted for the purpose of controlling damping-off of tobacco seedlings. Other plants were used in some cases to facilitate the work, but the principles apply equally well in a general way to all plants grown in seed beds and subject to the disease. A large portion of the experiments have been conducted in the forcing house, and the results are applicable therefore not only to damping-off in plant beds but also, in a large measure, to the disease in forcing houses. Tobacco growing in Wisconsin is an industry which returns approximately $6,000,000 annually to the growers of the state. The damping off disease is of frequent occurence in the plant beds and causes a considerable loss in the destruction of seedlings. Indirectly, such losses result in delayed transplanting, transplanting of inferior plants, and sometimes in reduced acreage, making the control of the disease of considerable local importance. Experiments on the control of damping off by several investigators on various crops and soils have indicated some variations in results, possibly due to differences in soil. Sandy loam and clay loam soil containing considerable humus have been used in the experiments cited in this bulletin, and hence the results apply particularly to those types of soil. The studies have been mainly confined to damping-off by *Pythium debaryanum* (Hesse), though the same disease produced by Rhizoctonia has also been studied in this connection sufficiently well to warrant the assumption that from a practical standpoint the control methods apply equally as well in both cases. Before taking up the subject of control it is well to mention briefly some of the characteristics of the casual organisms.

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THE CAUSAL ORGANISMS

Pythium debaryanum (Hesse) was first described and named by Hesse in 1874 (12) at which time he pointed out the destructiveness of this fungus as a parasite of seedlings. As early as 1881 De Bary (6) believed it generally present in garden soils of Europe and extended the list of host plants named by Hesse. Ward (32) in England, found it common in the garden soils of that country and studied its reproduction and relation to the host tissue. More recently, the economic importance of this fungus has been emphasized in the United States by Atkinson (1) as causing the damping off of seedlings.

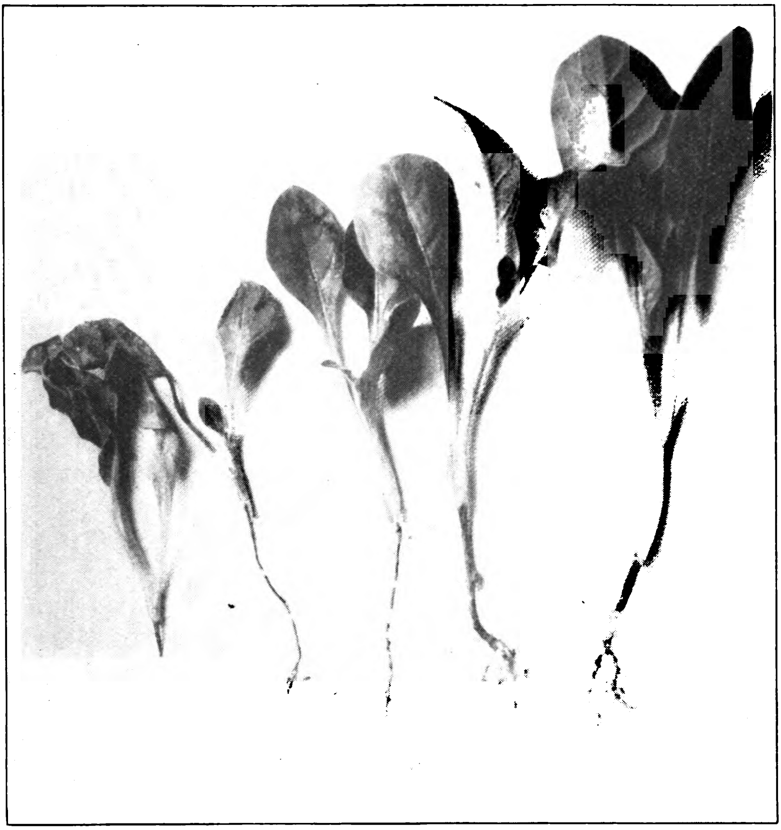

FIGURE I. TOBACCO PLANTS ATTACKED BY PYTHIUM DEBARYANUM.

Various stages of the disease are shown.

The attacks of this fungus are very largely confined to young plants. The fungus may, however, under exceptionally favorable weather conditions kill the embryo in the seed or grow upon old plants. The zone of first attack is practically always confined to the hypocotyl, either just at, or below the surface of the soil (Figure 1.) Under favorable conditions, however, the disease rapidly spreads up the stem of the plant and into the midrib of the leaves. The characteristic appearance of a seed bed attacked by damping-off is a bending over and wilting of the diseased plants.

Pythium debaryanum is quite readily distinguished in diseased areas from most other damping-off fungi. The coarse, non-septate, highly granular, irregularly branching mycelium (Figure II,) can be easily observed on the interior and exterior of the host tissue when bits of the freshly infected tissue are teased apart and examined under the microscope. Ordinarily, the diameter of the hyphae will be found to vary considerably, the older hyphae usually being the larger. The very young portions of hyphae are frequently finely granular, but become coarsely granular with age, while the oldest hyphae are usually emptied of their contents. The mycelium penetrates the cells of the young and succulent tissues readily, seeming particularly adapted to passing through cell walls and obtaining nourishment from the interior of the cells, whereas in tissues damped off by Rhizoctonia the hyphae are more generally found between the cells. Where they pass through the cell wall the diameter is characteristically much reduced.

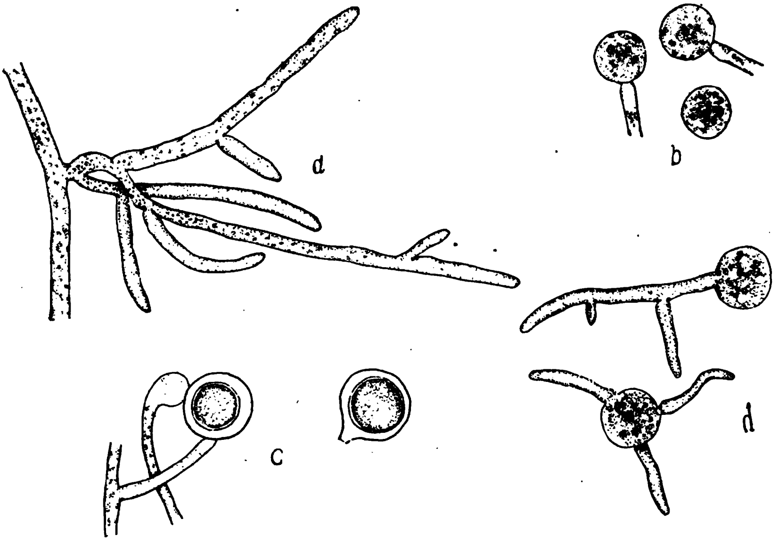

FIGURE II. MICROSCOPIC CHARACTERS OF PYTHIUM DEBARYANUM.

A, mycelium; b, conidia; c, oospores; d, germinating conidia.

Reproductive bodies are not ordinarily found in damped off plants, though they may be produced quite frequently in certain species of plants. For the study of reproductive bodies it is however, more convenient to obtain the fungus in pure culture upon various media. Thaxter's potato hard agar in petri dishes yields an abundance of conidia when inoculated with *Pythium debaryanum.* Oospores were found to be produced in great abundance upon sterile slices of green cucumber in petri dishes, or upon very young tobacco seedlings grown upon filter paper in petri dishes and inoculated with Pythium soon after germination. Zoospore producing bodies were not obtained upon any of various media tested for that purpose. The importance of the reproductive bodies in spreading the disease, or in carrying the fungus over unfavorable periods, seems comparitively unimportant, but this matter requires further study before anything definite can be said upon it.

Rhizoctonia was first described by De Condolle (7), in 1815, as a root destroying fungus. Since then it has been described as a root parasite upon a wide range of host plants in Europe. It was not until the early nineties that the fungus came to be recognized as a destructive parasite in field crops and plant beds in this country. Pammel (16) described Rhizoctonia as causing a root-rot of beets in 1891, and Atkinson (2) mentioned it as causing a damping-off of cotton in 1892 in Alabama and of various seedlings in New York (1) in 1895. Duggar and Stewart (8) have treated in some detail the occurrence of this fungus upon a large number of hosts in this country.

The genus Rhizoctonia includes several forms of sterile fungi which are recognized by certain characteristics of the mycelium and the manner of growth in pure culture. (Figure III.) The young branches are more or less narrowed at their point of union with the parent hypha and grow characteristically in a direction almost parallel to each other. A septum is also formed a short distance from the point of union with the parent hypha. The young hyphae are strongly vacuolated but this condition disappears in the older hyphae which are frequently yellowish in color. In pure culture on potato hard agar the growth is at first loose and white, but later becomes short, tufted, and brownish. Under the microscope these tufted growths are seen to consist of short cells, sharply constricted at the septa and irregularly branched. These shortened cells are capable at times of functioning as conidia. In older cultures brownish sclerotia are formed which, when placed under favorable conditions, are capable of producing a new mycelial growth, and hence serve to carry the fungus through unfavorable periods. In certain forms true spores are said to be produced.

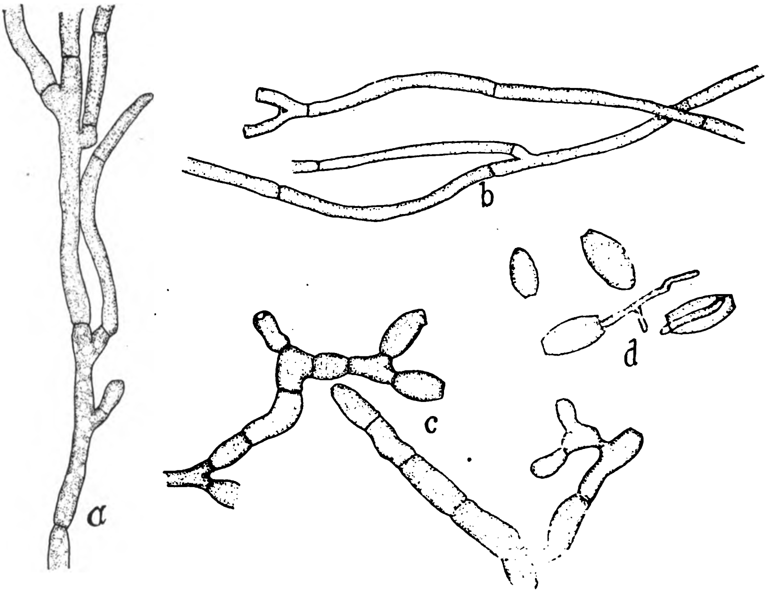

FIGURE III. MICROSCOPIC CHARACTERS OF RHIZOCTONIA.

A, young mycelium showing habit of branching; b, old, brown hyphae, usually empty; c, short tufted growth, characteristic in culture; d, cells resembling and functioning as conidia.

HOST PLANTS

Pythium debaryanum and Rhizoctonia sp. are now known to attack a wide range of plants[1] when favorable climatic condi-

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[1] The following lists, though probably not complete, serve to illustrate the types of plants upon which these fungi are parasitic. *Pythium debaryanum* has been described as parasitic upon white clover *(Trifoleum repens)*, European millet *(Panicum miliaceum)*, false flax *(Camelina sativa)*, shepherds purse *(Capsella bursa pastoris)*, white pine *(Pinus strobus)*, beet *(Beta vulgaris)*, orchid *(Stanhopea saccata)*, egg plant *(Solanum melogena)*, spurry *(Spergula arvensis)*, corn, *(Zea mays)*, cress *(Lepidium sativum)*, pigweed *(Amaranthus retroflexis)*, white mustard *(Brassica alba)*, cucumber *(Cucumis sativus)* and certain species of Viscaria, Lobelia and Gillia.

Rhizoctonia has been described by Duggar (8) and others as parasitic in this country upon bean *(Phaseolus vulgaris)*, beet, *(Beta vulgaris)*, carrot, *(Daucus carota)*, celery *(Apium graveolens)*, cotton *(Gossypium herbaceum)*, lettuce *(Lactuca sativa)*, potato *(Solanum tuberosum)*, radish *(Raphanus sativus)*, rhubarb *(Rheum rhaponticum)*, ornamental as-tions for their growth occur. Some plants are, however, very much more suspectible than others, owing to certain physiological or morphological factors. The amount of injury also depends markedly upon the manner of cultivation and the stage of development of the plants.

During my studies upon damping-off of seedlings I have observed *Pythium debaryanum* as occurring upon cress (*Lepidium sativum*), tobacco *(Nicotiana tabacum)*, lettuce *(Lactuca sativa)*, endive *(Cichorium endiva)* carnation cuttings *(Dianthus caryophyllus)*, cucumber *(Cucumis sativus)*, turnips *(Brassica rapa)*, cabbage *(Brassica oleracea)*, squash *(Cucurbita maxima)*, cauliflower *(Brassica oleracea var. botrytis)*, pumpkin *(Curcurbita pepo)*, mangle-wurzel *(Beta vulgaris var macrorhiza)*, balsam *(Impatiens balsamina)*, kohlrabi *(Brassica oleracea var. caulorapa)*, tomato *(Lycopersicum esculentum)*, beans *(Phaseolus vulgaris)* and geranium cuttings *(Pelargonium hortorum)*.

Rhizoctonia has been observed to occur parasitically at Madison upon cress *(Lepidium sativum)*, tobacco *(Nicotiana tabacum)*, lettuce *(Lactuca sativa)*, clover *(Trifoleum repens)*, sunflower *(Helianthus annuus)*, radish *(Raphanus sativa)*, egg plant *(Solanum melogena)*, pea *(Pisum sativum)*, celery *(Apium graveolens)*, tomato *(Lycopersicum esculentum)*, violet *(Viola affinis)*, beet *(Beta vulgaris)*, geranium cuttings *(Pelargonium hortorum)* and sweet Willam *(Dianthus barbatus)*.

HISTORICAL

The practice of heating soil by surface firing was probably practiced long before its actual sterilizing value was known. The benefits known to be derived were largely those of an improved physical condition of certain soils, the added fertilizer from the ashes of the burned material, and a reduction of weeds in the soil.

Atkinson (1) in 1895 pointed out several factors which influenced damping-off by Pythium in cutting-beds, suggested sev-

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paragus, *(Asparagus sprengeri)*, China aster *(Callistephus hortensis)*, carnation *(Dianthus caryophyllus)*, sweet william *(Dianthus barbatus)*, violet *(Viola odorata)*, lambs quarters *(Chenopodium album)*, tumble weed *(Amaranthus albus)*, pigweed *(Amaranthus retroflexus)*, white pine, cucumber, begonia, coleus, verbena, hydrangea, hardy candytuft, mammoth sage, phlox, pyrethum, snap dragon, raspberry, squash, clover, lucerne and peas.

eral cultural means for its control, and recommended steam sterilization in severe cases.

Stone (29) in 1900 emphasized the value of partial sterilization of forcing house soils, and its practical application for protection against the lettuce drop disease.

Selby (23) in 1906 recommended the use of 1-160 to 1-200 formalin (2-2½ pints to 50 gallons of water) for the control of bed rot of tobacco plants caused by Rhizoctonia. His experiments using this strength formalin gave partial control of the disease. Poor results, however, were obtained in some instances.

Jones (13) in 1906 working in Vermont, found that the use of 1-100 formalin reduced damping-off in pine seedlings from 90 per cent to 7½ per cent, and 1-200 formalin reduced the disease to 9 per cent.

Spaulding (26) in 1908 recommended the use of sulphuric acid (1 ounce to one gallon) against damping-off of coniferous seedlings, and obtained poor results with 1-100 formalin.

Gilbert (11) in 1909 using various methods of soil treatment for the control of root rot of tobacco *(Thielavia basicola)*, recommended steam sterilization. He obtained poor results with 1-100 formalin in most cases.

Scherffius (24) in 1911 working in the Transvaal, used five different methods of soil treatment against damping-off in tobacco plant beds, viz., (1) open fire; (2) boiling water; (3) steaming; (4) roasting; (5) formalin. All factors considered, he obtained the best results with the open fire method. Roasting gave almost as good results as the first and was closely followed by steaming. The formalin treatment was rated as fourth, and boiling water gave results but little better than untreated plots.

Russell and Petherbridge (21), in 1912, used carbon bisulphide and toluol on greenhouse soils and reported marked increase in plant growth due to the effect on soil organisms, but did not state definitely the effect on the damping-off fungi.

Gifford (10) in 1912 compared steam sterilization and formalin treatment for the prevention of damping-off of coniferous seedlings by Fusarium in particular, and recommends the use of one per cent formalin for its control.

Various other statements are to be found in literature recommending the use of potassium sulphide, potassium permanganate, lime, Bordeaux mixture, and potassium nitrate for the control of the damping-off diseases.

The status of the problem is such, following the work of the preceding investigators, that the subject appeared to need further study, especially along the following lines:—

1. The strength of formalin required for complete control of damping-off as with formalin 1-100 or weaker, previous investigators secured contradictory results, only partial control being obtained in most cases.
2. The relative value of other fungicides sometimes recommended for control.
3. The value and practicability of steam sterilization of soils in the field.

PREVENTIVES

Experimental Methods

The experimental data which is at hand upon the efficiency of various methods of soil sterilization against damping-off in plant beds is small and contradictory. This is due largely to the fact that the experiments have been carried on principally out of doors, where, owning to the influences of weather conditions, the data may in some instances be misleading. Furthermore, the control methods have been directed against the damping-off fungi as a whole which may again lead to complications from a scientific standpoint, though it may appear relatively unimportant from the standpoint of practice. Reinfection is also, of course, an important consideration and must be considered at all times where attempts are made to eliminate certain organisms from large exposed areas out of doors.

In the following experiments it has been attempted, as far as possible, to eliminate these factors, and to furnish conditions most favorable for the development of the disease. In a number of preliminary experiments begun in 1909 on forcing house benches, results were obtained which were indicative, but not entirely reliable because of changing atmospheric conditions and occasional reinfections. The results of these experiments will not, therefore, be given in detail. They served to show, however, that sprinkling the plants with dilute solutions of potassium sulphide, formalin, copper sulphate, ferrous sulphate, and ammonia at strengths below that toxic to plants was inefficient in checking the disease after it had once started.

Preliminary experiments in the fall of 1910 indicated that a satisfactory temperature and humidity for damping-off could be maintained in a small damp chamber, and that the possibility of reinfections through the air was practically nil. A large damp chamber 18 feet long and 3.5 feet wide was then constructed on one of the forcing house benches. (Figure IV.) The top was made of hot-bed sash placed about 2.5 feet above the bottom of the bench. The sides of the chamber were also partly glass, allowing sufficient light to enter from the sides so as not to cause the seedlings to grow spindly. The unit area used for soil treatment in this chamber consisted of a forcing house flat which measured 21 inches by 16 inches and 3 inches in depth, holding 28 to 30 pounds of soil. This chamber holds 23 flats of this size.

In earlier experiments the control was aimed at both Pythium and Rhizoctonia in the same soil, and no inoculations were made as all the soil used was found to contain these fungi naturally. It was observed that under certain conditions, particularly of temperature, Rhizoctonia would be the main casual organism of damping-off, while under other conditions Pythium seemed to predominate. It was also thought possible that a control measure might effectively restrain one organism and not the other. This complicated matters to such an extent that in the later experiments the soil and flats were all sterilized, and inoculations made in pure culture in the following manner:

The flats were filled with a soil composed of three parts of compost, two parts of garden loam, and one part of sand. They were then set one on top of the other, with one-fourth inch space between each, and a large, tight box inverted over them. Steam was run under this box from the forcing house heating system for one and one-half hours, which was sufficient to sterilize the soil so far as the damping-off fungi were concerned. By this method a temperature of practically 100 degrees Centigrade was maintained for one hour. The soil and flats, while still warm, were placed in the damp chamber, which had been previously flushed out with water and sprayed with a strong solution of copper sulphate.

About six days previous to this, pure cultures of Pythium and Rhizoctonia were started on corn meal. After the flats had cooled sufficiently, the corn meal cultures were spread in small pieces over the surfaces of the soil. The flats were then covered with plate glass which had been fumigated with formaldehyde gas over night. After four or five days the fungus had grown profusely into the soil from the corn meal. The soil was now worked up in order to obtain as even a distribution of the fungus through it as possible. The flats were then ready for treatment with the fungicides.

In the experiments described "sterile" checks are flats which were left uninoculated, and "untreated" checks are those which were inoculated with the disease, but not treated with any fungicide. The checks received the same amount of water as the treated flats. The amount of liquid fungicide used on all flats was 2500 cubic centimeters which was sufficient to saturate the soil to the bottom. After treatment the flats were again covered for 48 hours with the glass plates, which reduced evaporation to a minimum, and gave the volatile fungicides, especially, time to act. The covers were then removed and placed vertically between the flats preventing contamination from one flat to another. After four to six days the flats were sufficiently dried out to work the soil again, after which the seed was sown. The temperature of the chamber varied from 23 to 30 degrees Centigrade.

In the earlier experiments tobacco plants were used, but owing to the length of time required for germination and growth, garden cress *(Lepidium sativum)* was substituted in the later trials. This plant serves admirably for this purpose because of the readiness with which it damps off and the short time required for its germination and growth. Cress is to be looked upon as a sensitive indicator of the presence of any living damping-off fungus and as a measure of the efficiency of the fungicide under conditions favorable to the fungus.

EXPERIMENTS WITH FORMALIN

The trials made in treating the soil with formalin at various strengths were carried on in connection with the other treatments for comparative efficiency. On account of the importance of the formalin treatment, however, the flats treated with this chemical, with their checks, have been grouped into Table I. Formalin (40 per cent formaldehyde) of the best purity was used in the experiments. The experiment was carried on in four different series. In Series I and II, the casual organisms were both Pythium and Rhizoctonia, with tobacco seedlings used as host plants. In Series III and IV Pythium only was present in the soil, and cress was used as the host plant. In Series III, only the per cent of plants killed above ground was taken into consideration, while in Series IV the per cent of plants killed both above and below ground was considered. The formalin strengths used are given in parts by volume.

TABLE I. EFFECT OF FORMALIN SOIL TREATMENT ON DAMPING-OFF

SERIES	PERCENT OF PLANTS DISEASED						
	Un-treated soil	Strength of Formalin Used					Sterile soil
		1-200	1-150	1-100	1-75	1-50	
I.........	50	10	10	....	....	....	0
	90	....	90	....	....	....	0
	75	....	80	....	....	....	....
	....	....	75	....	....	....	....
II.........	80	....	....	10	....	....	0
	....	....	....	20	....	....	0
	....	....	....	20	....	....	....
	....	....	....	80	....	....	....
	....	....	....	10	....	....	....
	....	....	....	40	....	....	....
III*.........	15	75	....	65	....	0	0
	20	....	....	....	....	0	0
IV.........	85	....	95	65	35	0	0
	90	....	....	75	40	0	0

*Apparently low per cent of disease in untreated soil is due to fact that the large per cent of plants killed below the surface were not included in this estimate.

It will be seen from this data that formalin treatment at the strength recommended by various authors, i. e. 1-100 to 1-200 is practically no better than no treatment for damping off under the conditions of these experiments. Series II shows that 1-100 formalin will not control Rhizoctonia, as microscopical examination showed this fungus to be the main cause of the damping-off in this case. The wide range of results in Series II is due largely to the flats being affected by different temperatures, a factor which was better controlled in the later experiments. In Series III and IV the flats treated contained only Pythium, which was not destroyed by 1-75 formalin and lesser strengths, but was completely controlled by 1-50 formalin (Figure V). It is possible that a strength somewhat less than used to control Py-

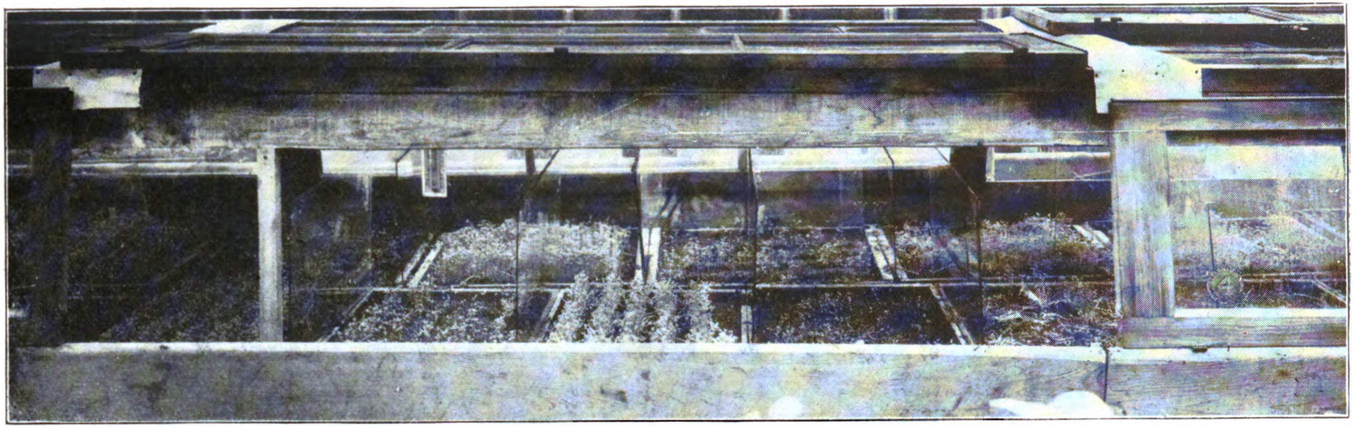

FIGURE IV. DAMP CHAMBER USED IN CONTROL EXPERIMENTS.
The flats are separated by glass partitions to avoid infection.

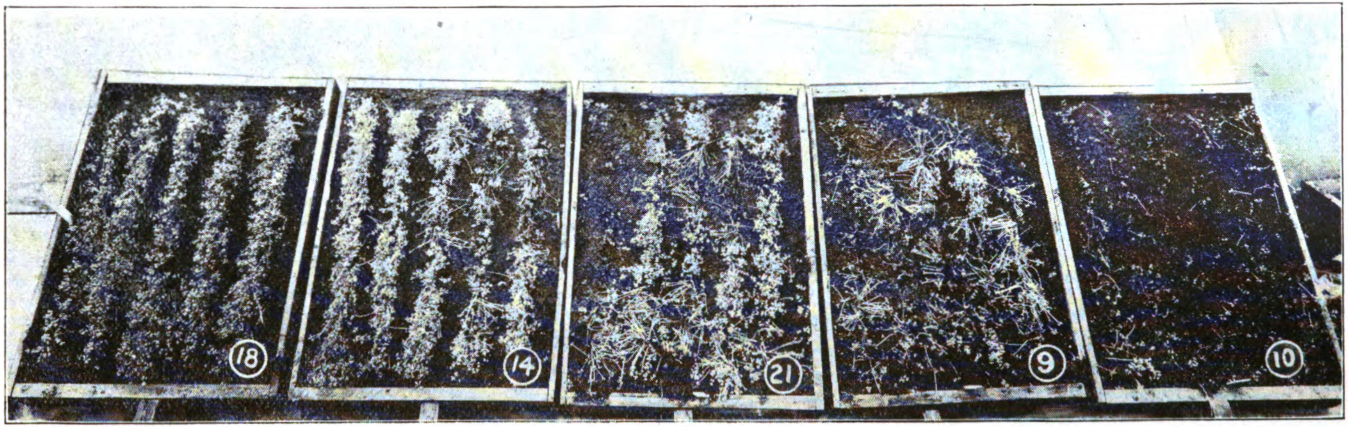

FIGURE V. INFLUENCE OF FORMALIN SOIL TREATMENT ON DAMPING-OFF.
Growth of cress on Pythium infected soil treated with formalin of various strengths; (18) 1–50 formalin; (14) 1–75 formalin; (21) 1–100 formalin; (9) 1–150; (10) no treatment. Strengths below 1–50 failed to completely control the disease.

thium will destroy the mycelium of the sterile fungus, Rhizoctonia, but that is immaterial from a practical standpoint, as a strength sufficient to destroy both fungi must be used in order to be certain of results. A strength of 1-50 formalin may be slightly in excess of what is actually required to kill Pythium, but it it a common practice in using fungicides to work with strengths somewhat beyond that which is actually required, provided no injury to the host occurs. Selby (23) recommends the use of 2-2½ pints of formalin to 50 gallons of water, (1-160 to 1-200,) one gallon of the solution per square foot of seed bed, applying it at intervals of a few hours, as most soils will not take up this amount of water at one time.

According to the writer's observations, two quarts of the 1-50 solution applied to each square foot is sufficient, especially if the bed is covered with some material to hold in the fumes. This is on the principle that a strong solution acting for a shorter time is more efficient than a weaker one acting for a longer time. The stronger formalin will also penetrate downward into the soil further, and the soil can be worked sooner than when twice the amount of solution is added. The practice should then be to use four quarts of formalin per 50 gallons (one barrel) of water, applying at the rate of two quarts per square foot, or approximately one barrel to one rod of seed bed six feet in width.

An interesting observation of the effect of formaldehyde upon the fungus has arisen in this connection. If we separate the amount of injury caused by Pythium on cress seedlings into the percentage of disease above ground and percentage of disease below ground, we find that the percentage of seeds killed before germination in the untreated checks is very high. Table II illustrates the effect of formalin of different strengths upon the relative rate of development of the fungus.

TABLE II. INFLUENCE OF FORMALIN ON DAMPING-OFF FUNGUS

Treatment	Strength	Percent disease below surface	Percent disease above surface
Untreated check		80	10
Formalin	1—150	0	95
Formalin	1—100	0	75
Formalin	1—75	0	40
Formalin	1—50	0	0
Steam sterile		0	0

According to this data, 1-150 formalin effectively prevents the fungus from attacking the cress seed in the soil. This has also been observed to be the case in 1-200 formalin. On the soil treated with 1-150 formalin, the plants damped off rapidly, however, soon after they appeared above ground. The percentage of damping-off up to a certain time decreased with the increase of strength of formalin, the weaker strengths of formalin (1-75 to 1-200) having a checking influence upon the fungus which disappears in time. This may explain the fact that relatively good results have been obtained with the lower strength of formalin. If the climatic conditions favorable for the development of the fungus come on a time before the checking influence of the formalin has passed off, good results may be obtained, but if these favorable conditions appear some time later, the treatment with the formalin at the lower strengths may be practically valueless. This checking influence of formalin below 1-75 will usually pass off in from 10 to 15 days after treatment, and is consequently of little value, especially to those plants requiring longer periods in the plant beds. There can be but little doubt that 1-50 formalin kills the fungus as the treated soil remains apparently sterile for weeks, providing infection from the outside does not occur. The partial control obtained by Selby and Gifford, using formalin at strengths of 1-100 and below, can be explained by this checking influence of the fungicide together with unfavorable weather conditions for the parasite after the formalin had left the soil.

MISCELLANEOUS SOIL TREATMENTS

During the course of the experiments with formalin, several other fungicides were tried for the prevention of damping-off. The strength of the fungicides used, especially that of the non-volatile ones, is limited by the toxicity to the plants. Several preliminary experiments were carried on in order to determine the percentage strength of the fungicide which could be used without too much injury to the plants. These preliminary experiments indicated to some extent the uselessness of the application of many of these substances, but further trials were continued in connection with the formalin controls and some data obtained, which is grouped in the following table.

TABLE III. PER CENT OF DISEASED PLANTS IN MISCELLANEOUS SOIL TREATMENTS

		Experiment 1.			Experiment 2.		
Treatment	Per cent by weight	Treated	Untreated check	Sterile check	Treated	Untreated check	Sterile check
Potassium sulphide	0.8	15	20	0	....	....	....
Potassium sulphide	1.	....	....	....	95	85	0
Lime sulphur†	2*	20	20	0	70	85	0
Copper sulphate	0.8	15	15	0	....	....	....
Copper sulphate	1.	....	....	....	5	90	0
Copper acetate	0.12	18	20	0	....	....	....
Copper acetate	0.2	....	....	....	35	85	0
Copper nitrate	0 8	20	20	0	....	....	....
Bordeaux mixture‡	1.	10	20	0	25	85	0
Sulphuric acid*	0 4*	20	20	0	....	....	....
Sulphuric acid	0.5*	....	....	....	65	85	0
Potassium permanganate	1.	....	....	....	92	85	0
Potassium nitrate	0.5	10	20	0	....	....	....
Mercuric chloride	0.12	60	20	0	....	....	....
Hot water	....	25	20	0	85	85	0

*Per cent by volume.
†Sherwin Williams Lime Sulphur Solution, sp gr. 1.2491.
‡5—5—50 formula.
§Sp. gr, 1.84.

A comparison of the percentage of disease in treated and untreated soil in Table III shows little or no benefit from the application of these substances as fungicides to the soil in amounts which will permit of seed germination and plant growth. These figures do not, however, indicate the true state of affairs in all cases. Certain of the chemical agents appeared to produce some inhibitory action upon the development of the fungus for a short time after the application, but this action apparently disappeared too soon to be of any value. This inhibitory action on the fungus was most conspicuous as effecting the percentage of seedlings killed below the surface of the ground. In the case, for instance, of treatment with 2% lime sulphur fully 75 per cent of the plants appeared above ground before damping-off, as compared with only 5 to 10 per cent in the case of untreated soil. Treatment of a steam sterile soil with lime sulphur (2 per cent) showed retarded germination and growth of cress, but a perfect stand. Similar inhibitory action was also observed to occur in the potassium sulphide, copper sulphate, and mercuric chloride treatments. The inhibitory action of these fungicides upon fungus development was correlated with an inhibition of plant growth, and consequently little hope for their value as soil fungicides is maintained. The essentials of a good soil fungicide appear to be that it must first possess strong fungicidal action and secondly that it must be volatile in order that it may be freed from soil before the seed is sown.

Covering the soil with screenings of sphagnum moss gave indications of checking the disease to some extent, and is worthy of trial on a small scale. Sand covers gave poor results in some cases and are of doubtful value for checking the disease. Steam sterile surface soil two inches in depth, allowed to remain on the surface soil from 6 to 7 days before the sowing of the seed, appeared to be of no value. A three inch layer of sterile surface soil, however, showed very little disease except that which was later determined to have arisen from outside infection. Under practical conditions a three to four inch layer of sterile surface soil should in most cases effectively prevent damping-off, at least during the period when the seedlings are most susceptible. The use of such substances as lime, ammonia, toluol and carbon bisulphide have also given negative results in the control of damping-off so far as they have been tried in these experiments.

STERILIZATION BY HEAT

Several methods have been devised by various experimenters for the sterilization of soil by heat. The writer found that forcing house flats such as those used in the experiments could be cheaply and efficiently sterilized under an inverted box into which streaming steam was run for one and one-half hours from the forcing house heating system. Fourteen flats were sterilized at a time, or an equivalent of 28 to 30 square feet of soil. This method, though impracticable out of doors, is a good one for a small greenhouse where seedlings and cuttings are started in flats.

The methods used for sterilizing soil by heat, which lend themselves to out door seed bed conditions, fall under three heads, (1) steaming, (2) surface firing, (3) roasting.

The most practical method yet devised for the sterilization of seed beds by steam is the "inverted pan method". This method was first used by Shamel for sterilizing nematode infested soils in Florida. A galvanized iron pan, six feet by ten feet and six inches deep is inverted over the area to be sterilized after it has been prepard for seeding. As the edges of the pan are sharp they can be pressed into the soil an inch or more, thus forming a tight compartment under the pan into which the steam is run 30—60 minutes from a boiler at a pressure of 80—150 pounds. The time of steaming depends largely upon the type of soil and its moisture content and compactness. Loose sandy, moist but not wet soils, are more easily and rapidly steamed than heavy and wet soils. The pan used at this station (Figure VI) in tobacco seed-bed experiments was made 8 inches in depth, which is probably more desirable in some cases. The pan could be made 12 feet in length without loosing any efficiency where large boilers are used. The handles should preferably be placed on the sides instead of on the ends so that the pan could be moved from one section of the bed to another without the operators walking on the sterilized soil. The weight of such a pan is approximately 400 pounds. A one inch steam hose should be used to connect it with the boiler. A traction engine such as is used for threshing is most convenient to furnish the steam.

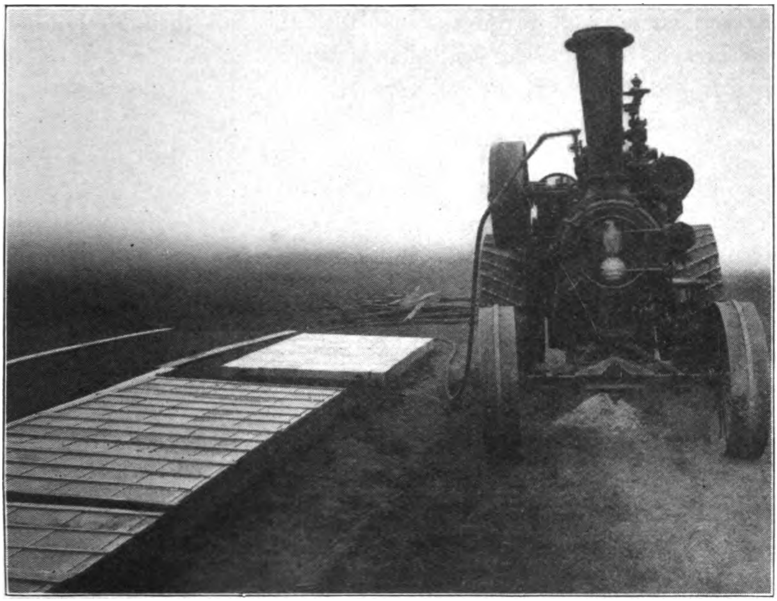

FIGURE VI. STERILIZING SEED BEDS BY THE "INVERTED PAN" METHOD.

Other methods of steaming are the "sub-surface pipe" system and the "steam rake" method. The former consists of an underground system of 1½ inch perforated pipes, 18 inches apart, running lengthwise of the bed, 6 to 8 inches below the surface. The perforations, about ¼ inch in size and 6 inches apart, should be on the under side of the pipe. Steam is run into these pipes at a pressure of 80 to 100 pounds for a period of about 1 to 2 hours. The method is practicable only when beds are located for several years in the same place. The steam rake or harrow method consists in forcing steam into the soil through hollow perforated pipes resembling the "spikes" of a harrow. The results are the same, but the method is usually regarded as less efficient than those previously mentioned.

Surface firing has been quite popular in the past, but it is giving way to other methods, owing largely to the scarcity of combustible material in many places, and to the labor connected with the process. The method consists simply in producing a hot fire for an hour or more over the section of the bed to be sterilized after it has been fertilized and fitted for seeding. Any combustible material may be used such as brush, straw, or dry wood.

Roasting or "pan-firing" requires the removal of part of the soil from the seed bed into the pan and returning it after being sterilized. The pan may be simply a large piece of sheet iron, resting upon supports, underneath which is a fire. This pan should be set on the bed and the soil to a depth of 6 inches on one side shoveled upon it and roasted for an hour, being careful not to let it become so dry that the vegetable matter is burned out. Then a like area on the other side of the bed is sterilized and in the meantime the soil underneath the pan has been sufficiently heated, and the pan may be moved to another section of the seed-bed and the operation repeated.

EXPERIMENTS UNDER FIELD CONDITIONS

In the spring of 1912 the "inverted pan" method, surface firing, and formalin treatment (1–100 solution and two quarts per square foot) were compared on tobacco beds. Steam was run into the inverted pan for various lengths of time ranging from 25 to 45 minutes, at a pressure varying from 100 pounds down to 25 pounds in some cases at the end of the application.

As no damping-off occurred in the unsterilized plots, the comparative value of the different periods of heating could not be determined, and the experiment will not be given in detail. Some interesting results were obtained, however, upon the effect on weeds and growth of the plants. The weed seeds were all killed at as low an exposure as 25 minutes, starting at 80 pounds and running down to 25 pounds pressure. (Figure IX.) The plants in the unsterilized plots were not one-half as large as those in the sterilized plots one month after sowing the seed.

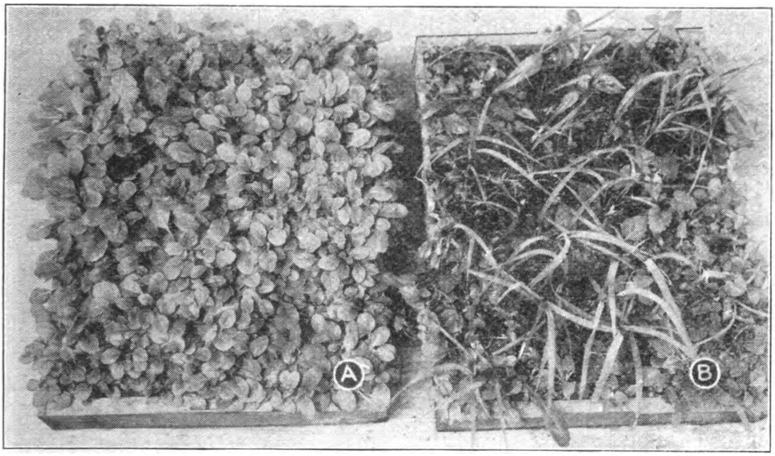

FIGURE VII. STEAMING NOT ONLY PREVENTS DISEASE BUT ALSO KILLS WEEDS.
A, Soil steamed. B, Soil not steamed.

(Figure VIII.) The cost of one weeding of the untreated plots was equal to the cost of steaming an equal area. This together with an assurance against bed-rot and other pests, and an increased growth in the plants, made the process an economical one and well worthy of use on all tobacco farms. The sterilizing of tobacco seed beds by the "inverted pan method" can be most cheaply done by a few neighboring farmers in cooperation, or better still by a person who owns a steam traction engine who will do the sterilizing by contract at so much per rod of seed bed.

The surface fired plot was second best, being much better than the untreated plots, and no weeds were present. The formalin treated plots came third, the principal effect being a considerable reduction in the number of weeds, although this effect is not usually claimed for it. Considerable stimulation in the growth of the plants was also noticed.

The practical value of steaming tobacco beds was further demonstrated in the spring of 1913, when the writer steamed approximately ten thousand square feet of soil for different growers in Rock County, Wisconsin. The results were so markedly successful in destroying weeds and producing earlier and better plants, that these and other growers who saw the demonstrations are preparing to steam all their seed beds hereafter. The results of field experiments have shown on the whole that it probably does not pay to steam for damping-off alone, since its occurrence is comparatively infrequent. The other important results of soil steaming however, such as increasing the growth and uniformity of the plants, killing the weed seeds and injurious insects which may be in the soil, and preventing infection with other diseases make it an economical, if not a necessary process.

SECONDARY EFFECTS OF SOIL TREATMENTS

The treatment of soils by heat and liquid fungicides to destroy the undesirable organisms results in a number of secondary effects which have been the subject of some study in recent years. These effects are primarily perceptible upon the plants grown in the treated soils. It has been found that the physical, chemical, and biological nature of the soil is altered by heating.

The following tabulation will illustrate these effects upon the germination and growth of seedlings as observed from flats treated by heat and by various chemicals used at the strengths mentioned. The unit area used for treatment was that of a forcing house flat holding from 28–30 pounds of soil. Twenty-five hundred cubic centimeters of the solution was applied to each flat in every case.

As we are interested in the secondary effect of sterilization by heat and formalin principally, we will consider these facts briefly. The first effect that can be noticed in a heat sterilized soil is a change of physical condition which results in a more rapid drying out of the surface layer of soil. According to Lyon and Bizzell (15,) this appears to be due to a loosening of soil, which aids more rapid percolation downward. This effect cannot be said to be particularly disadvantageous except when the seedlings are very young and need moisture at the surface, when it is readily overcome by two or three additional waterings.

TABLE IV. EFFECTS OF SOIL TREATMENTS ON PLANTS

Treatment	Per cent by weight	Germination	Growth after 15 days
Steaming 100° C. 1½ hrs		Retarded	Stimulated
Formalin, 1-50 (sowing after 3 days)		Retarded	Stimulated
Formalin, 1-50 (sowing after 7 days)		No effect	Stimulated
Copper sulphate	1	Retarded	Inhibited
Copper acetate	0.2	No effect	Slight inhibition
Copper nitrate	0.8	No effect	Inhibited
Ammonium copper carbonate	0.12	Markedly retarded	Inhibited
Bordeaux mixture	1.	Slight retardation	Slight inhibition
Potassium sulphide	1.	Marked retardation	No effect
Lime sulphur sp. gr. 1.2491	1.*	Retarded	No effect
Sulphuric acid c. p.	0.5*	No effect	Slight inhibition
Potassium permanganate	1.	Slight retardation	No effect
Potassium nitrate	0.5	No effect	No effect
Ferrous sulphate	1.	No effect	No effect
Hot water		No effect	No effect
Mercuric chloride	.12	Retarded	Inhibited
Surface firing		Retarded	Stimulated

* Percent by volume.

Gifford (10), however, reports that in the case of coniferous seedlings the loss of moisture in the upper layers of soil as a result of steam sterilization is a disadvantage of sufficient importance to prevent its general adoption against damping-off.

Pfeiffer and Franke (19), on steaming soil for three hours at a pressure of one atmosphere, found that the heated soil produced a crop of greater dry weight and higher nitrogen content than the unheated.

Schulze (25) noticed that the sterilization produced injurious effects upon plant growth in the early stages of development, but that as the plants grew older, they grew more vigorously in the sterilized soils.

Pickering (18) found that heating moist soil to temperatures from 60 degrees to 150 degrees Centigrade, retarded germination of seeds, and in some cases decreased the total number of seeds germinating. He also obtained increased growth of plants in heated soil, which was attributed to an increase in soluble nitrogen.

Koch and Luken (14) heated sandy soil with steam for two hours at two atmospheres pressure, and found that the soluble plant food was increased. They also found that the immediate results of heating were injurious, but that it was unimportant and that the later yield was improved.

Russell and Hutchinson (20) heated soils to 98 degrees C. and found that an increased production of ammonia followed for at least 150 days. This increase in ammonification is attributed to an increase in the number of ammonifying bacteria in the soil as a result of the destruction of the larger organisms, especially protozoa, which destroy the ammonifying bacteria, and are hence injurious to the productiveness of soils.

Lyon and Bizzell (15) steamed different soils under a pressure of two atmospheres for periods of two and four hours and found a marked injurious effect resulting, as shown by the growth of plants in the soil. The time required for the soils to recover from the treatment was usually in the same order as their relative productiveness. These experiments indicate that the injurious effect varies with the amount of steaming and the type of soil. These results are not quite applicable to partial soil sterilization against damping-off since the amount of steaming is much less and the recovery consequently more rapid in the ordinary soil treatment.

Russell and Petherbridge (21), using carbon bisulphide, toluol, and steam sterilization, report a retardation in germination, but a greatly increased yield as a result of sterilization of greenhouse soils.

These results, as a whole, are in accord with the writer's observations of the effect of steam treated soil upon seedlings of cress and tobacco. The very marked increase in growth of tobacco plants on heated soil makes it appear that this practice should be generally adopted by tobacco growers. It is recommended particularly to those growers who have yearly difficulty in obtaining an early stand of vigorous plants. The heating of soil does not appear to affect all soils similarly. According to Stone (30), soils low in organic matter may be injured by heating, and this fact should be considered before preparing to heat certain soils. In the writers experience with nearly a score of Wisconsin soils, heating has never resulted injuriously.

The effect of formalin sterilization upon soils has not been the subject of as much experimentation, and the real nature of the effect has not, to the writer's knowledge, been determined. If the seed is sown before most of the fumes of formaldehyde have left the ground, germination is retarded. If the soil is allowed to dry out for a week, however, this effect disappears. It is interesting to note, also, an increased vigor and growth of seedlings grown upon formalin sterilized soil. This effect with the strengths of formalin used in these experiments occurs usually sooner, but not to as great an extent as in the case of steam sterilization. This increase is again possibly due to an effect upon the chemical nature of the soil or, more probably, to the effect upon its bacteriological content. It has also been supposed that the plants may take up small amounts of formaldehyde directly, resulting in a stimulation of growth. The amount of weeds was also much reduced in formalin treated soil, an effect also noted by Clinton (3) in treating soil for root-rot of tobacco.

CULTURAL REMEDIES

Although prevention by such measures as have been described is the only certain protection against damping-off, much can be done in a cultural way towards obtaining a relatively small loss from the disease.

Infected soils. As an increased amount of the causal organism in the soil will naturally be present in a soil where damping-off has previously occurred, later seedlings in the same soil will be more likely to damp off when the weather conditions become favorable to the fungus. It is, therefore, a wise precaution to avoid sowing seed in the same beds where the disease has previously occured, unless the soil is sterilized by heat or formalin. It has been found possible by repeated sowings of cress in diseased soil to fill it so completely with the causal organisms that practically every seed in the later sowings is killed before it germinates. A change of seed bed is, therefore, desirable and necessary in case of bad infestations. New ground, especially fall plowed, old blue grass sod has shown itself in many cases to contain very little, if any, of the damping-off fungi, besides being relatively free from weed seeds, thus making it a good seed bed if the soil is otherwise of the right nature.

Thick sowing. Although the damping-off fungi are capable of attacking plants standing singly under especially favorable weather conditions, no method of culture is more conducive to damping-off in the seed beds than thick sowing of seed, with the resultant crowding of plants. The following table illustrates the relation between the amount of seed sown and the percentage area damped off. The experiments were carried on with tobacco in flats in the greenhouse where favorable conditions for damping-off were maintained.

TABLE NO. V. EFFECT OF THICK SOWING ON PERCENTAGE OF DISEASED PLANTS

FLAT NO.	WEIGHT OF SEED SOWN.		Plants diseased.
	Per flat.	Per 100 sq. ft.	
	Grams.	Ounces.	Per cent.
1	0.1	0.16	0
2	0.2	0.33	0
3	0.3	0.49	8
4	0.4	0.66	15
5	0.5	0.83	35
6	0.6	0.99	75
7	0.7	1.16	80
8	0.8	1.33	80
9	0.9	1.49	92
10	1.0	1.60	96

The first signs of the disease occured in flat No. 10 very soon after the plants had obtained their first two leaves. The disease started last in flat No. 3, but not until the plants were of considerable size and were crowded. This record illustrates quite markedly that the amount of damping-off varies directly with the thickness of sowing. (Figure X). This is due to several factors, the first of which is probably the increased humidity of the atmosphere around the base of plants when crowded, as a result of lessened air circulation and increased shading. Crowding also affords easier transfer of the fungus from one plant to another and is instrumental in producing more rapidly growing and succulent stems, which are more susceptible to attack. Thick sowing is especially likely to occur in sowing small seed. One ounce of tobacco seed with a germinating capacity of 90 to 95 per cent should be made to cover 5 to 6 rods of seed bed six feet in width, whereas in practice it is frequently sown on two rods.

Soil Types. Certain types of soil are particularly favorable for the damping-off fungi, and should therefore be avoided. Such are the soils which contain a high percentage of undecomposed vegetable matter, and those which are poorly drained. In an experiment using mixtures of varying percentages of manure,

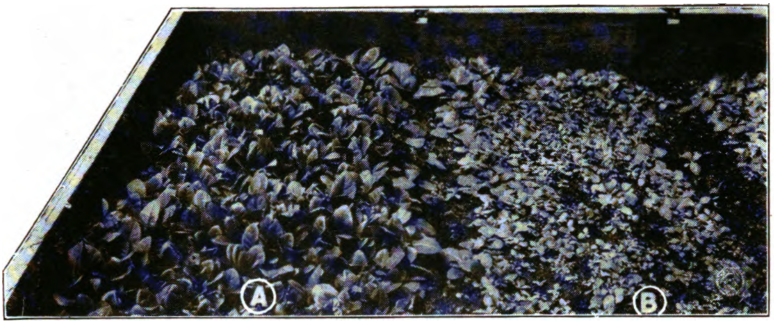

FIGURE VIII. STEAMING INCREASES VIGOR AND UNIFORMITY OF PLANTS.

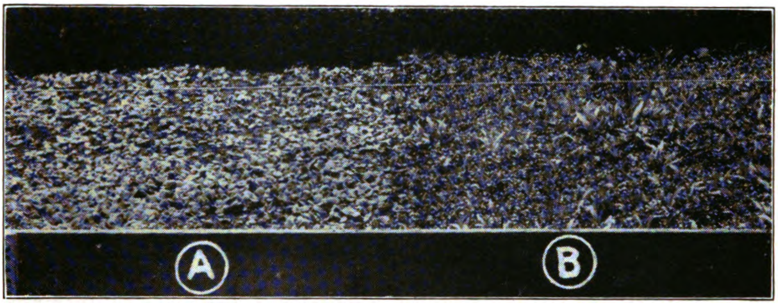

FIGURE IX. STEAMING ELIMINATES THE COST OF WEEDING.
a, steam sterilized; b, no treatment.

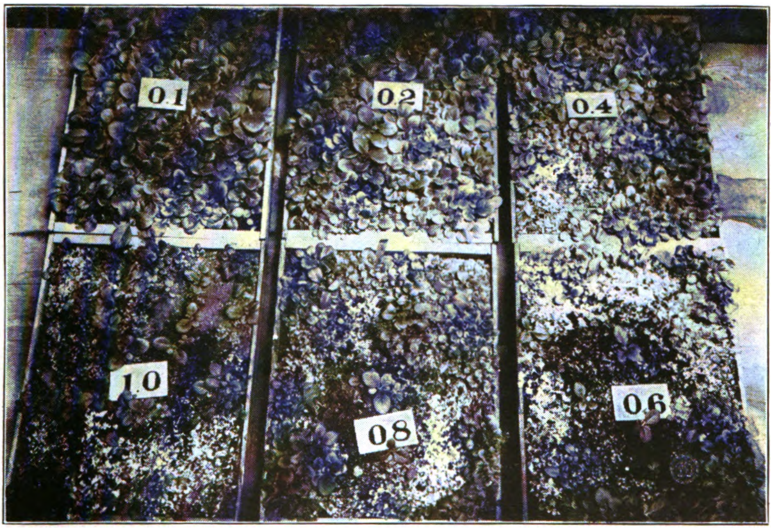

FIGURE X. THICKNESS OF SOWING FAVORS DAMPING OFF.
Figures on boxes show amount of seed in grams, sown in each flat.

compost, garden loam and sand, sterilized and inoculated with Pythium, the most rapid spread and prolific growth of the fungus was obtained in a mixture of 50 per cent manure and 50 per cent garden loam, and the least growth in garden loam and pure sand. As the fungus lives on the organic matter of the soil in the absence of the host plant, it is reasonable to suppose that the fungus content of soils rich in organic matter is greater than that in soils poor in organic matter. This is one reason why a layer of pure sand on the surface of the bed should afford a considerable protection against damping-off. Yet experiments show that the application of a layer of sand does not prevent damping-off. This may be partially explained as follows: The damping-off fungi attack a plant just at or above the surface of the soil probably because the fungus is aerobic. Therefore in a perfectly aerated soil the disease would be more likely to occur further down on the hypocotyl. A layer of sand or moss, however, still allows considerable aeration down to the surface of the soil proper and hence permits the fungous development and consequent disease below the artificially applied layer. Some advantage in sand and moss, however, is undoubtedly supplied by its mulching qualities, on account of which the application of less water to the beds is required. A lower average percentage of moisture in the surface soil is thus maintained.

Soil Moisture. The following experiment was planned for the purpose of determining the relation of the development of Pythium in the soil to the moisture content of the soil. Dry sand was graded into various sizes by means of 20, 40, 80, and 100 mesh sieves. Ten grams of each grade was put into each of six test tubes. To each tube was then added enough dilute nutrient solution to make up to the calculated percentages of moisture given in Table VI. The tubes were then sterilized and inoculated with Pythium. After 4 days when considerable growth had been made in most of the tubes the following results were noted on the 20 mesh sand. The same general relations as regards the surface and sub-surface growth existed in the other grades of sand.

This data indicates that the fungus remains below the surface in a well drained soil when the moisture content is low. When the moisture content of the soil is high, however, or when it is saturated, as frequently occurs in poorly drained seed beds, the fungous growth is forced to the surface. This is presumably on account of the lack of oxygen, since the fungus is aerobic. At the surface of a saturated or nearly saturated soil it finds ideal conditions for development, both as regards oxygen and moisture, and if plants are present which are susceptible to the disease, damping-off is almost certain to occur. In well drained soils, however, the fungous development is most active some small distance beneath the surface, where there is both sufficient moisture and oxygen. This zone may be, and frequently is, below the base of the hypocotyl, in which case the plants may escape attack from the disease.

TABLE VI. INFLUENCE OF SOIL MOISTURE ON GROWTH OF PYTHIUM.

Number	Moisture	Amount of surface growth	Amount of sub-surface growth
	Per cent		
1	0	None	None
2	10	None	Slight
3	15	None	Slight
4	20	Slight	Marked
5	25	Fair	Marked
6	30*	Very marked	None

(*)Sand saturated

Effect of Transplanting Diseased Plants. In the spring of 1908 tobacco seedlings were transplanted to the field from a bed badly infested with damping off. Many plants were set out which had a trace of the disease upon the stem, though the badly diseased plants were discarded. Soon after transplanting several plants died in the field, and examination showed them to have damped-off, undoubtedly from the disease transferred from the plant bed. Later in the season when the plants were about half grown, several gave the appearance of being stunted and yellow, as if from malnutrition. Examination showed in all cases a full or partial girdling of the stem below the surface of the soil. (FigureXI). At the time of the maturity of the crop about two per cent of the plants, apparently normal in their growth, were broken down by a heavy wind storm. Practically all these plants showed a break just below the surface of the ground, where the stem was wholly or partially girdled, to all appearances due to a continuation of the disease started in the plant bed. In 1909 healthy and infected plants were set out in the field in separate rows, the infected plants, with few exceptions, made a normal growth, and examination when they reached maturity showed no injury or only scars where the disease had apparently continued, but later healed over. The recovery of the infected plants was attributed to the relatively dry season.

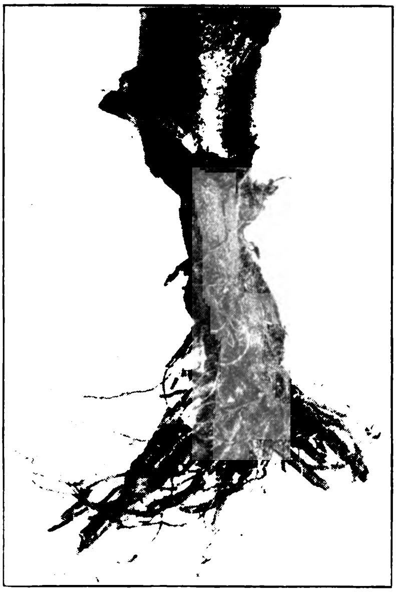

FIGURE XI. GIRDLING OF TOBACCO STALK DUE TO DAMPING OFF DISEASE.

A type of field injury which results in the affected plants being stunted in their growth and readily broken down by wind storms.

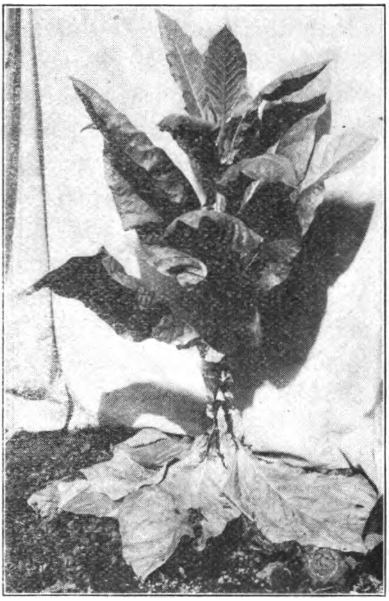

FIGURE XII. INJURY FROM PYTHIUM DE BARYANUM IN THE FIELD.

The disease frequently extends a considerable distance up the stalk and passes into the leaves causing them to droop and die.

The season of 1912 was again very wet, and a large amount of of this field injury due to damping-off took place. In a plot not over one-half acre in extent, over two hundred plants were counted which were diseased. The injuries on the whole, however, extended further up on the stalk than in the previous years. Ordinarily, the stalk was blackened a distance of 18 to 36 inches above the surface of the ground, producing a condition of the nature of ''blackleg''. The disease also frequently entered the leaves, causing them to droop and turn yellow from lack of food. (Figure XII). Selby (22) observed a similar trouble in Ohio tobacco and considered it to be associated with damping-off due to Rhizoctonia. A similar disease is also reported from Java, being due to *Phytophthora nicotinianae* (Breda de Haan), and a "blackleg" of tobacco in Japan has been reported as due to *Bacillus nicotinianae* by Uyeda (31). Clinton (4) has observed a "canker disease" in Connecticut which is without doubt identical to this, and he suggests that it may be a bacterial disease.

At this station *Pythium debaryanum* was repeatedly observed on diseased plants at the margin of the diseased areas and taken in pure culture therefrom. *Pythium debaryanum* in this case appears to possess an extraordinary degree of parasitism, being usually known as attacking only succulent seedlings. These observations indicate that it is poor practice to transplant seedlings with any signs of the damping-off disease upon their stems. The persons who pull the plants from the plant beds for transplanting should therefore be required to discard all plants showing browned or blackend spots on the stem. The possibility of direct infection in the field seems most remote.

CHECKING THE DISEASE

The control measures considered up to this time, that is, those of prevention and culture, are means which must be taken before the seed is sown, and cannot be applied thereafter. More often the practical plant grower does not consider these factors and desires a remedy after the disease has begun to do considerable injury in the plant beds. This is an impossible task providing the weather conditions remain favorable to the disease; hence the importance of foresight in the use of preventive and cultural methods. However if the weather conditions are not continually favorable to damping-off, much can be done towards checking the disease in plant beds by a proper regulation of the temperature and moisture conditions in hot beds and cold frames.

Temperature Relations. Providing other conditions are favorable, damping-off is aided by relatively high temperatures of the soil and surrounding atmosphere. The optimum temperature for growth of Pythium is about 33 degrees C. (92 degrees F.) while that of Rhizoctonia lies at about 25 degrees C. (77 degrees F.). The growth of either below 16 degrees C. (61 degrees F.) is very slow. When damping-off has started among the plants the grower should endeavor to keep the temperature as far below the optimum as possible. Presupposing the presence of both fungi as actively causing the damping-off, this will be almost an impossible task owing to the wide range of temperature which they cover. However, when damping-off occurs and the temperature of the glass or canvas covered frame is above 70 degrees F., it is important to remove the covers to reduce the temperature as much as possible.

Moisture Relations. As was pointed out before, a relatively high percentage of moisture in the soil favors damping-off. This is also true of the humidity of the atmosphere surrounding the plants. The best aerial growth of the fungi is only obtained in an atmosphere saturated with moisture. Where aerial growth of the fungi occurs, the spread of the disease from plant to plant is very much more rapid than when it has to make its way through the moist soil or through parts of plants in contact with each other, because of the lessened resistance offered by passage through the air. The humidity of the atmosphere of covered plant beds is usually much higher than that outside. Good ventilation, provided by partly or entirely removing the covers, will quickly reduce this humidity and dry out the surface soil more rapidly, hence effectively decreasing or entirely checking the spread of the disease.

Infected areas. Damping-off frequently starts at one point in the seed bed and spreads from this point as a center of infection. Where only a few of these centers of infection occur, and the weather promises to be favorable for the disease for some time, much can be done towards checking the trouble by removing the infected plants and soil from the bed, together with the surrounding area somewhat beyond the last signs of disease. In case of the damping-off of valuable plants where only a few are grown, it is best to prick out the healthy plants and transplant them separately into other soil. Spraying the plants with potassium sulphide, Bordeaux mixture, formalin, ammonia, mercuric chloride, lime or sulphur in an effort to check the disease after it had once started gave negative results.

SUMMARY

Damping-off of seedlings in plant beds in Wisconsin is commonly caused by one of two fungi, *Pythium debaryanum* or Rhizoctonia.

These fungi are capable of attacking a large variety of different plants, as well as of living upon the dead organic matter of the soil, and are hence extremely persistent when once present in the soil.

The disease is favored particularly by certain weather conditions, such as excessive moisture and high temperatures, and very little can be done to check the disease when such conditions prevail. Therefore this necessitates the adoption of methods which kill the fungi in order to prevent the disease.

The preventive methods are of such a nature that they must be applied before the sowing of the seed, since the methods used to kill the fungi would also kill the seed.

A number of chemical agents have been tested as fungicides against damping-off, but of these formalin alone has proven of any value under conditions favorable to damping-off.

Treatment of the soil with formalin at strengths of one part formalin to one hundred parts of water and lesser strengths, as frequently recommended, does not kill the fungus. Although it may hold the disease in check for some time, it will allow it to develop later if weather conditions permit. The value of formalin at these strengths is therefore dependent, in a large measure, upon the time of the appearance of weather conditions favorable for damping-off.

Treating the soil with 1-50 formalin at the rate of two quarts per square foot of soil, will kill the fungi which cause damping-off, and will hence effectively prevent damping-off under the most favorable weather conditions for fungous growth. Formalin soil treatment is also somewhat beneficial in stimulating the plant growth and in killing some weed seeds. The chief objections are the cost of the formalin, the time required for it to act, and the time required for the soil to dry out.

Sterilization of the soil by heat has proven the most satisfactory method of preventing damping-off from all standpoints, excepting that under certain conditions it may be more expensive than the formalin treatment. Steam sterilization by the "inverted pan" method is especially recommended where a steam traction engine is on the farm or can be obtained in the neighborhood.

Aside from preventing damping-off, there are several beneficial secondary effects of soil sterilization by heat. These are principally the killing of all weed seeds and insect pests of the soil, and greatly increased size and vigor of plant grown on such soil.

As a cultural control of damping-off, growers should avoid infected, poorly drained soils and thick sowing of seed.

The only means of checking the disease after it has occured in the plant beds is to remove the covers in order to reduce the temperature and the moisture of the soil and of the air immediately above the plants.

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4

STATE OF WISCONSIN

IN SUPREME COURT

State No. I. January Term, 1914.

STATE OF WISCONSIN, on Relation of
Walter C. Owen, Attorney General,
Plaintiff,

vs.

JOHN S. DONALD, Secretary of State,
Defendant.

SYLLABUS.

1. Given a subject of litigation within the original authority of the court, involving some question of great public importance and an appropriate application to afford jurisdiction of adversary parties, the court may entertain it and permit or order the scope thereof to be broadened as such importance may require, without regard to change of mere form of action or the nature of the appropriate redress.
2. In the circumstances stated, if the application exhibits a subject of controversy, however narrow, the court may, and, if great public interest demands it, will, upon application of a party to the record, or on its own motion, permit or order any broadening of issues or addition of parties advisable to bring into the litigation all questions so connected with the initial matter as to constitute an entirety.
3. To amend the fundamental law the prescribed procedure must be followed with substantial accuracy. *State &c. vs. Marcus.*
4. In proposing an amendment to the constitution the legislature acts ministerially under a grant of power defining its limitations

and manner of its exercise, so that it should observe the restraints and particulars of the grant. *State vs. Marcus.*

5. A legislative proposal to amend the constitution, in order to be submitted to the electors, must have been agreed to by each house of one legislature, be spread upon its journals in understandable connection with a recorded yea and nay vote, showing that a majority of all members of such house favored the same, and there must be a like recorded vote at the next legislature as to the precise question agreed to before, though a second full entry on the journals is not necessary, but is advisable.
6. Passage of the ordinary bill directing submission of a proposed amendment of the fundamental law to the people, reciting that it has been agreed to by the two houses at two sessions of the legislature, does not take the place of the constitutional procedure. *State &c. vs. Marcus.*
7. Whether a purported amendment to the fundamental law is such in fact, is a judicial question which the court may determine when it appears, from any viewpoint, involved in a controversy submitted for decision, and must determine, in case of its being vital to the final result. *State &c. vs. Marcus, supra.*
8. A judicial determination that the prescribed constitutional steps are essential to efficiency in submitting to the people a proposal to amend the constitution, does not involve technical adherence to form,—only that the sovereign command must be obeyed.
9. An agreement between the state and another, in the form of an ordinary land contract, the former promising, absolutely, to pay the purchase price of property at stated times in consideration of the promise to sell, creates state debt, within the meaning of Sec. 4, Art. VIII of the Constitution and is prohibited thereby.
10. Such an instrument, as in number 8 is evidence of state debt, within the meaning of Sec. 9, Art. VIII of the constitution, and is prohibited thereby.
11. A legislative appropriation of money to buy land, purporting to confer authority to contract therefor and pay as money becomes available, does not include power to obligate the state upon fixed, time, interest bearing absolute obligations.
12. The Commissioners of Public Lands, under the constitution, constitute an artificial person, intrusted with control of the trust fund lands and trust funds as therein mentioned, though the control, as to lands is restricted "to school lands proper" and university lands, except as otherwise provided by the legislature, and in case of the state obtaining money from such fund, in form, by borrowing, the relations of debtor and creditor are

thereby created, within the prohibition of the constitution in respect to incurring state indebtedness.

13. The money obtained by the state from 1860 to 1870, in manner indicated in No. 11, and used for state purposes, created state indebtedness within sec. 4, Art. VIII of the constitution, and the certificates issued therefor, constitute evidences of indebtedness within sec. 9 thereof, and such indebtedness and such evidences are within the prohibitions of such sections.
14. June 1, 1911, the state was under disability, in any event, to incur indebtedness, since it was then indebted in excess of $1,000,000.
15. Regardless of the state indebtedness existing June 1, 1911, on account of dues to the trust funds, it was under disability to incur ordinary land purchase indebtedness, since such is not within the emergency purposes mentioned in secs. 6 and 7 of Art. VIII of the constitution.
16. Aside from state indebtedness to the trust fund, the land contracts of January 1, 1911, with other such obligations exceeded the constitutional limitation of the capacity of the state to incur indebtedness.
17. The refund by the United States to the state of money obtained from the trust funds which was carried into the general fund and used for general state purposes did not affect the status of the state indebtedness.
18. What constitutes "works of internal improvement" within the prohibition of sec. 10, Art. VIII of the constitution, is a judicial question.
19. The term "works of internal improvement" used in Sec. 10, Art. VIII of the constitution, refers to a broad principle as to state engagement in works of internal improvement, and not to any particular species thereof.
20. The constitutional prohibition as to "works of internal improvement" is not restricted to such as appertain to business enterprises and public purposes not mere avenues of trade and commerce. It extends to every kind of public improvement not necessary or convenient for use of the state in carrying out its essentially governmental function as fenced about by the constitution.
21. Creation of a forest reserve, permanent improvement thereof for the production of forest products, conservation and equalization of the flow of natural waters for effect on climatic conditions, development of water power on the reserve and business operations to make such reserve a source of gain for increase thereof or replenishment of the public treasury is, taken as a whole, a "work of internal improvement."
22. Temporary reservation of trust fund lands from sale for conservation thereof, protection of such land from fire hazard and the state generally from such hazard, purchase of lands by the com-

missioners of public lands by legislative authority to block up within existing trust lands for the purpose of increasing proceeds of the latter, the investment in the additional lands within a reasonable time to be returned into the general fund if furnished therefrom as legitimate state expense, and care of the land during the waiting time for sale so as to utilize the forest products of an annual character and to save dead and dying and mature timber is not a "work of internal improvement" though the incidental effect may be such an improvement.

23. Withdrawal from sale of "school lands proper" or university lands, except in the discretion of the constitutional commissioners and for the benefit of the trust is prohibited by sections 7 and 8, Art. XI of the Constitution.

23a. The school lands of the swamp land class and the drainage land may be withdrawn from sale, in the discretion of the legislature, so long as the purpose thereof is conservation of the lands for the benefit of the purpose of the grant from the United States and the dedication of moneys arising from the school land class as stated in the sections to follow.

24. Sec. 2, Art. X of the constitution dedicated to educational purposes "all moneys arising from any grant to this state from the United States where the purposes of the grant were not so specified" so as to create an obligatory trust for some other purposes.

25. Under the federal grants to this state of wet and overflowed lands, commonly called the swamp land grants, for the purpose of draining such lands, so far as necessary, it was given to the state to decide upon the necessity, leaving excess "lands where the purposes of such grant are not specified" within the meaning of the constitution.

26. The constitutional dedication impressed the land which the state derived from the swamp land grants with a trust for educational purposes, so far as such lands were not necessary for the particular purposes mentioned in the grant, to the extent that all moneys arising therefrom constitute a part of the school fund.

27. The purpose of the federal grant and the provision of the constitution together created a disability of the legislature to dispose of the land for any other purpose than that mentioned in such grant and dedication.

28. Upon the legislature definitely deciding between the two purposes for which the lands derived from the swamp land grants were held, those appropriated to the constitutional purpose, automatically became a part of the state school fund land under the same trusts, reservations and restrictions as are provided in the constitution, to the extent that all moneys arising therefrom belong to the school fund to the same extent as proceeds of lands granted to the state for educational purposes.

29. The partition of the swamp lands under Chap. 437, Laws of 1865, one-half for school purposes and one-half for drainage purposes, relieved the former from any trust for the latter and gave the school land half the status of school lands as regards moneys arising therefrom subject to be added to by any future express or implied determination to further limit the amount of land to be devoted to drainage purposes.

30. The constitution acted upon all lands derived from the swamp land grants immediately upon title thereto being vested in the state, dedicating the same to the extent aforesaid, irrevocably, to educational purposes so far as not found necessary for the primary purposes of the grant.

31. Chapter 367, Laws of 1897, Chap. 450, Laws of 1903 and Chap. 264, Laws of 1905, and all other acts and parts of acts, so far as they would otherwise supersede sec. 250 and sec. 251 of the Statutes of 1898, embodying the provisions of the legislative enactment of 1865, the confirmatory enactment of 1869 and the recognition thereof for a long term of years are invalid. Said sections 250 and 251 are a part of the written law of the state, any act of the legislature to the contrary notwithstanding.

31a. While the proceeds of lands granted to the state for educational purposes and the moneys arising from lands of the swamp land grant which were dedicated to such purposes by sec. 2, Art. 10 of the Constitution form one "school fund" irrevocably pledged to school purposes, there are two classes of lands, the first being "school lands proper" and under the jurisdiction of the Commissioners of school and university lands to the extent mentioned in sections 7 and 8 of such article and the second the lands derived from the swamp land grant which are under the control of the legislature subject to duty on its part to administer the same for the purpose of producing moneys for such school fund.

32. The fundamental law means what its framers and the people approving of it intended to have it mean, that to be determined by reading it in the light of the circumstances in which they were placed, particularly, as to the objects they had in view.

33. When the intent of the framers of the constitution looking at it from the environment of its makers, is plain, and the language they used to express such intent is susceptible of a narrow and a broad construction, the one favorable to such intent should be adopted as the correct one and extended so far as necessary to fully vitalize such intent.

34. In making the fundamental law a government was created with limited functions, specified expressly or by necessary inference, and the power of taxation limited to carry out such functions.

35. The purpose for which the power of taxation may be used is covered in general terms by sec. 5, Art. VIII of the constitution and is denominated "expenses of the state."

36. The power to appropriate money out of the state treasury is limited by the power of taxation to create a fund to appropriate from.

37. The power to appropriate money out of the public treasury being co-extensive with the power to tax, it is inherently and also impliedly and expressly limited by the constitutional functions of government.

38. In determining whether a particular purpose may be constitutionally served by state appropriations or taxation, the fundamental law must be examined from the plane the people occupied when they created the government.

39. The power to tax is not retained by the Legislature for all purposes not mentioned in the constitution; but the mention, expressly and impliedly, of particulars as recognized governmental purposes, excludes all others.

40. The language of the constitution as to state taxation, though, in form, a grant of power, is, in fact, a limitation thereof. It must be read in the light of the rule peculiarly adaptable to the construction of such constitutional provisions, *expressio unius exclusio alterius.*

41. The constitution contemplated a legislative estimate for each year of the amount of money required to defray the expenses of the state for such year in the carrying out of its governmental function, and addition thereto of any deficiency in the amount provided for in the previous year, a legislative estimate of the income for the ensuing year, other than from ordinary taxation, a balance struck between the two, and, if thereby found necessary a legislative levy of a state tax to cover the deficiency.

42. The purposes for which taxes may be levied are denominated public purposes, not in the broad general sense; but in the constitutional sense of such statewide purposes as are contemplated by the functions of government under the system created by the fundamental law.

43. Where there is no public purpose, in the sense of carrying on the machinery of government, there is no power to tax.

44. The plan embodied in the constitution contemplates confining the subject of state appropriations and taxation as near to the people as practicable.

45. If there were no fundamental limitations on the power of taxation, the inherent nature of organized society would limit it to the legitimate purposes of government.

46. The maxim "the right to tax is the right to destroy" is appropriate to a system of government based on possession by the people of privileges by sovereign grace. It is applicable to a system based on possession by them of inherent rights, only upon the theory that the taxing activity is confined to execution of governmental functions within fundamental restraints.

47. There may be destruction by means of taxation for governmental purposes under a system based on possession by the people of mere privileges, which would be confiscation under a system based on inherent rights, and so unconstitutional both by the inherent nature of the government and by fundamental restraints as well.

48. Any purpose, whether public or not, not included in the plan of government created by the constitution, is outside the limitation upon the right to take private property for public use by the power of taxation, and outside the power to appropriate money.

49. Where there is no benefit to the property owner of any character which is, to some extent, common, there is no right to tax; the underlying principle of taxation being that in return for taxation there is a consideration either of a pecuniary or protective nature to person or property or both.

50. The demands of charity in a foreign jurisdiction, however urgent, do not afford a legitimate basis for taxation. There is no such basis except in the uses of the government levying the tax in execution of its legitimate functions.

51. The practice, however extensive, in foreign jurisdictions, of creating permanent forest reserves by using proceeds of public taxation regardless of the limitations of the police power and fundamental prohibitions as to state engagement in works of internal improvement,—is unimportant respecting the legitimacy of legislative imposition of such burdens here, except as it bears on the question of whether there is reasonable ground for belief that promotion of public welfare under the police power calls for such creations.

52. So far as creation of forest reserves is a subject within the scope of the police power, that being a judicial question, and the means adopted to that end are appropriate and not unduly oppressive,—that being a legislative question, within the boundaries of reason,—and neither the subject nor the means are prohibited, it is a constitutional exercise of the police power.

53. The cost of governmental activity within the limitations specified in number 43, is state expense within the meaning of Section 5, Art. VIII of the constitution.

54. What is within the police power, in its broad sense, must be determined from the viewpoint of the American system of constitutional liberty based on inherent rights regulated by law, and not on ancient and foreign systems based on the theory that the individual possesses only privileges which are absolutely in sovereign power to take partly or wholly away.

55. The police power extends to everything promotive of public welfare, but exercise of it is limited by the spirit of the fundamental law and some express provisions therein besides.

56. When not within some express fundamental limitation any governmental activity within the police power which promotes the purpose for which governments are instituted among men deriving their just powers from the consent of the governed, is legitimate.

57. Governmental activity, not prohibited, and appropriate to the purposes mentioned in number 48, so far as it conserves and promotes efficiency of inherent rights, is legitimate: anything further, going to the extent of impairment or destruction of such rights is condemned by the spirit of the constitution.

58. Governmental activity within the scope of the police power, otherwise legitimate, which is within the field of the express prohibition of the state engaging in works of internal improvement, is condemned by the constitution.

59. The power of the federal government over the public lands and that of any state over lands which it owns in its proprietary capacity, has no relevancy to the situation in this state in regard to state handling of lands held in trust for particular purposes.

60. The police power is the broadest in scope of any field of governmental activity. It is inherent in the very nature of organic society. We do not look into the fundamental law to find it or define it but only for limitations upon it.

61. The police power has limitations, both inherent and fundamental; it is the most powerful instrumentality for good when properly used and likewise for oppression when not so used.

62. In view of the possible benefits as well as dangers with which the police power was conceived to be pregnant, in the creation of our system of government, a well understood standard of disability as to its exercise and some express disabilities, were provided and also authority created to defend such standard.

63. Whether within constitutional limitations as to express prohibitions, creation of a permanent forest reserve at state expense is within the scope of the police power as to means of promoting the public welfare, is a matter within legislative discretion. But if, under the particular circumstances, the means adopted are either not appropriate or are unduly oppressive, they are condemned by the constitution and it is the duty of the court to give voice thereto.

63a. Reforestation and afforestation within limits stated in the opinion, and other activities within such limits provided for in the forestry legislation are legitimate, partly referable to the police power and partly to the state function to care for and conserve the lands held by it in trust for granted and constitutionally dedicated purposes and the cost of such administration would be "state expense" within the meaning of sec. 5, Art. VIII of the Constitution.

64. Trust fund lands and trust funds having been confused with other lands and funds, particularly the general state fund and forestry funds and moneys have been drawn from such funds and invested in other lands, and operations occurred creating confusion between the various funds and trust fund lands,—an equitable lien may be held to result upon the general and forest funds in favor of the trust funds and property to the extent necessary to restore the latter funds and property, so far as practicable, both as to amount of fund and property.

65. For the purpose of rendering a judgment as indicated in number 57 efficient, the court, in the exercise of its general jurisdiction to carry out its judgments may make all necessary orders required to fully carry out such judgment and for that purpose order a reference to a referee with a special master as assistant and settle the controversy, finally, upon the coming in of the report, judicially determining the amount of each of the different kinds of property belonging to each fund.

66. Chapter 740, laws of 1913, providing for assessing trust fund land in particular taxing districts by a special method, also for special authority as to reviewing the assessment, obtaining a reequalization of the relative assessment of property in different taxing districts of a county and taxing the lands for local purposes at the expense of the general fund of the state, is void, because
    a. It appropriates state money for local purposes.
    b. It violates the constitutional right of local self-government.
    c. It is a special law for the assessment and collection of taxes.

67. Sections 1494—132 to 134, specially limiting the capacity of particular counties to realize on their tax title lands by compelling such counties to sell their tax title lands to the state at cost, while other counties may sell similar lands when and at such price as their governing boards may see fit, and affording former owners of lands in particular case less advantages for redressing wrongs in respect to tax deeds on their lands than is possessed in general is unconstitutional, because
    a. It violates the constitutional requirement for singleness and uniformity of town and county government so far as practicable.
    b. It is a special act for the collection of taxes.
    c. It takes county property to which it is entitled the same as a private individual, without rendering therefor a constitutional equivalent.
    d. It violates the equality clauses of the fundamental law.

(Syllabus by MARSHALL, J.)

Mandamus proceedings to compel the Secretary of State to audit a claim in favor of the G. F. Sanborn Company for payment of an account claimed to be due such company on a land contract between it and the State of Wisconsin.

The petition for the writ, in addition to essential and appropriate matters, contained, in substance, this statement of facts: June 1, 1911, under §1072—1 and §1494—61 Stats., in a contract, in writing, between G. F. Sanborn Company and the State of Wisconsin, it was agreed that the former should sell the latter certain lands for $90,076.11, payable $30,076.11 down and $20,000 on the first day of each year for three years thereafter, with interest at 6% per annum, payable annually. All payments except the last have been made. The proposed purchase should be completed to enable the State Forester to carry on systematic forestry work and fire protection. There is money for such completion in the appropriate fund and payment without delay will be a saving to the State in interest. The Secretary of State refuses to audit the claim for such payment and threatens not to audit any such claim because of doubt as to the validity of such contracts and of the statute purporting to authorize them, under §10, Art. VIII, State Constitution, and that he will not be justified in considering them valid before such doubt shall have been judicially solved. Irreparable damage will occur to the State and general prejudice to the executive officers of the Forestry Board, unless such contract shall be carried out.

On such petition an alternative writ of mandamus was duly issued to bring up for adjudication the controversy indicated.

In due course, respondent and defendant, Secretary of State, demurred to the petition for insufficiency.

In considering the issue thus raised it seemed that several serious questions were involved in whether money should be paid out of the State Treasury upon contracts made under the statutes aforesaid; that such questions reached the whole state forestry scheme of appropriating state lands for forestry purposes, purchasing other lands for such purposes, paying therefor out of the proceeds of existing state lands and money raised by taxation and using the lands in the manner contemplated by such scheme.

The whole subject having been put within reach of the court by the mandamus action, it was determined that the great public interests involved should not be prejudiced and the state officers embarrassed in performing their duties by any delay within its power to reasonably prevent, and, accordingly it declined to decide the mere narrow issue raised by the petition and demurrer thereto, and determined to permit the demurrer to be withdrawn and an answer to be interposed, presenting every existing matter of defense in order that all questions in relation to defendant's duty might be so solved as to protect him, the state and its officers in respect to use of money for forestry purposes.

In aid of consummating the result suggested, the court mentioned the following for consideration by eminent counsel representing the secretary of state:

1. Has the Forestry Board correctly construed the statute in presuming to have authority to bind the state by long time interest bearing obligations?

2. Is the basis, itself, of the forestry scheme,—the legislative diversion of the land and proceeds thereof granted to the State for particular purposes to a different one, legitimate?

3. Is using revenue raised by present taxation to promote the production or improvement of forests for the benefit of future generations, a public purpose within the meaning of the constitution?

4. Are interest bearing obligations of the State in excess of $100,000 valid in any event?

5. Is the creation of interest bearing obligation of the state of a less amount than $100,000 proper in view of existing indebtedness of the state to the trust funds, or otherwise?

The court, prefacing the order entered, said:

"All such matters, and perhaps still others, upon due consideration, aided by eminent counsel, may be deemed worthy of judicial interference and of being brought to the attention of the court in this litigation in an appropriate way. The case is of great importance. The best service which eminent counsel can afford would be appropriate to the situation and, in the public interest, should be called to the work by the parties and thus the court given all the legitimate aid practicable in arriving at a proper conclusion.''

The way being thus opened for bringing the great subject respecting the forestry scheme in its entirety to the bar of the court and submitting it for decision with the best professional services obtainable to illuminate the same, eminent counsel appeared upon both sides,—resulting in the permission to withdraw the demurrer being acted upon and an answer being interposed tendering issue as to all the questions suggested by the court and others. These, in substance, are the facts pleaded:

The contract in question is one of several of the same nature. Each is in the ordinary form of a land contract. There is mutuality of obligations therein,—on the one side a positive promise to pay the stipulated price for the land specified, and on the other, a like promise to convey the land upon payment being made. The particular contract and several of the others, provided for payment of interest and for deferred payments of principal,—in some cases until 1921. The contracts were made at different dates—the first April 21st, 1908 and the last September 7th, 1912. The aggregate amount of land covered by all the contracts is 57,016.33 acres, the purchase price $220,893.46, and the price per acre from $2.50 to $4.60. The total amount of deferred payments is $190,817.35. None of the contracts have been fully paid. The Sanborn contract was for 25,736.23 acres of land at $90,076.11, $30,076.11 of which was paid down when the contract was finally consummated August 22nd, 1911, leaving $60,000 to be paid in three installments of $20,000 each, one payable each year and the last June 1st, 1914, all to draw interest at the rate of 6% per annum. The last payment with the accrued interest is unpaid and is what the Secretary of State refused to audit, precipitating this litigation. The total amount due on all the contracts is now $130,817.35, exclusive of interest. The Sanborn contract bears date June 1st, 1911. Negotiations in respect to it preceded said date by a considerable period. They had proceeded so far, by March 28th, 1911, that deeds, in due form, for conveying the land to the state were made which were thereafter deposited with the Central Wisconsin Trust Company for delivery on payment of the purchase price. The contract was assigned to such company July 18th, 1911; but final consummation and making of the down payment waited upon approval of the abstracts of title which occurred August 21st, 1911. The officers of the state in making the purchase in its behalf depended upon Chapter 264, Laws of 1905, and Chapter 639, Laws of 1911 (§ 1042—1 Stats. 1913) for authority. At the date of the Sanborn contract there was in the forestry fund accumulated under the act of 1905, $31,161.33, which was derived from the sale of swamp lands, and in the tax title fund referable to section 1494—131 to 1494—135, inclusive, Stats. 1911, $53.87, and when the down payment was made $10,053.87 in the latter fund and $41,741.23 in the former. Such payment was taken out of the general fund depending upon §1072—1 Par. 1, Stats.

In some of the towns where said lands and other forest lands are situated, the local authorities claim the right to include them in property for general taxation under §1092m, Stats. 1913. Proceedings have been taken to tax the State trust lands against the state and pay the taxes to the several taxing districts out of its general fund.

2. North of township line 33 the State owns trust fund lands as follows:

School fund lands, 24,840 acres obtained under Paragraph 1, §7 Enabling Act and §2, Art. 10, State Constitution.

University lands 560 acres, obtained under the Federal act of June 12, 1838.

Agricultural College lands, 40 acres, obtained by the Federal Act of January 2, 1862.

Normal School lands, 1800 acres, referable to the Federal grant of September 28, 1850, as amended.

Swamp lands 240,000 acres, through the Federal grant of September 28, 1850, and the Act of Congress of March 2, 1855.

19,138 acres derived through the Federal grant of June 27, 1906, this being specifically for forestry purposes.

A large number of small unsurveyed and unattached islands in inland lakes granted to the state for forestry purposes by the Federal Act of August 22, 1912.

4,321.07 acres conveyed to the State September 6, 1912, for forestry purposes only, by the Nebagamon Lumber Company.

Pursuant to §1494—43 Stats., the State Forestry Board assumed control of all the swamp lands and withdrew them from sale as held for forestry purposes only. The rest of the trust fund lands have not been so appropriated but are liable to be at any time. Such other trust fund lands, specially granted to the State for specific purposes, have been withdrawn from sale by the Land Commissioners because the present selling price is too low. Claiming to act under the forestry statute, a considerable amount of trust fund lands have been exchanged for other lands which are asserted to be a part of the forestry reserve.

The primary title to all the lands in the forestry reserve is referable to the Virginia Cession deed of March 1, 1787, conveying the same as follows:

> "Unto the United States in Congress assembled, for the benefit of the said states, all right, title and claim, as well of soil as jurisdiction, which this commonwealth hath to the territory or tract of country within the limits of the Virginia charter, situate, lying and being, to the northwest of the river Ohio * * * upon condition that the territory so ceded shall be laid out and formed into states * * * having the same rights of sovereignty, freedom and independence as the other states * * *
> That all the lands within the territory so ceded to the United States * * * shall be considered as a common fund for the use and benefit of such of the United States as have become or shall become members of the Confederation of federal alliance of the said States, Virginia inclusive, according to their usual respective proportions in the general charge and expenditure, and shall be faithfully and bona fide disposed of for that purpose and for no other purpose whatever."

3. In 1862 and 1863 the state incurred $100,000 of bonded indebtedness for the construction, in part, of the state capitol and in part of a hospital for insane. Such indebtedness still ex-

ists in the form of obligations to the state trust funds, evidenced by 7% certificate of indebtedness.

During the Civil War the State for war and other purposes, incurred bonded indebtedness to an amount exceeding $2,000,000. In the course of time it was all funded into 7% certificates of indebtedness to the State trust fund, which are now outstanding. Prior to 1866, the state accumulated $528,000 by general taxation for the purpose of paying, in part, the public debt, but by Chapter 80 of the laws of that year it was diverted to other purposes.

The Congress of the United States duly provided for making good to the State the money advanced to it for war purposes, which was done from time to time, in the aggregate, principal and interest, to about $2,257,291.74, as follows:

Sept. 2, 1861,	$205,000.00,
July 18 and Sept. 30, 1862,	257,163.83,
May 19, 1865,	300,238.26,
Mar. 2, 1870,	219,742.06,
Mar. 31, 1873,	54,279.12,
Dec. 31, 1875,	10,347.53,
Apr. 11, 1888,	24,102.86,
1903,	458,677.90,
1905,	727,740.18.
	$2,257,291.74.

Of the indebtedness incurred by the State during the Civil War, part of the money being taken directly from the trust funds on the pretence of borrowing it, and the balance obtained by bonds, the United States refused to make good to the amount of $766,200, upon the ground of its having been used for state purposes only.

The money refunded, as stated, instead of being covered into the trust fund, thus making good so far its depletion and cancelling the certificates of indebtedness then held, to the amount of some $2,250,000.00, was put into the general fund and used for general state purposes, leaving the state indebtedness as before, which has ever since existed.

4. The state indebtedness aforesaid on the $100,000 of bonds was not authorized by Sec. 6, Art. 8 of the Constitution, limiting the power of the State to contract debts exceeding $100,000 and conditioning exercise of the power to necessity for defraying extraordinary expenditures, to a vote of all the members elected to each house of the Legislature in favor of the same, taken by yeas and nays, and the law providing for the levying of an annual tax sufficient to pay the annual interest on the debt and the principal within five years from the passage of the law and the appropriation of the proceeds of the taxes to payment of such principal and interest,—the law in that regard not to be repealed nor the taxes postponed or diminished in advance of the principal and interest being wholly paid. Nor was it authorized by §7 of such Article, which empowers the state to borrow money to repel an invasion, suppress insurrection or defend the state in time of war, the money to be used exclusively for the object for which the loan was authorized or to the repayment of the debt thereby created. Nor was it otherwise authorized, but, on the contrary, was prohibited by the constitution. The existence of the $100,000 of bonds in 1862 and 1863 for building purposes, which have never been paid, precluded legitimately contracting other indebtedness such as that on the lands in question.

The limitations in Section 6 aforesaid require loans under such section to be made in compliance therewith. So, in any event, the right of the state to incur indebtedness was exhausted before the land contracts were made.

5. The attempted appropriation of the State trust fund lands by §1494—43, Stats. 1913, and other statutes, to state forestry purposes, and to authorize the sale of said lands, or exchange of them with private parties for other lands, is within the prohibitions of Section 2 and 6, Article 10 of the State constitution setting aside, among other things, the proceeds of all lands granted to the state for educational purposes, except University lands, and all moneys arising from any grant where the purposes of such grant are not specified, as a separate fund to be called the school fund, the interest on which and all other revenues

derived from the school lands to be exclusively applied, so far as needed, to the support and maintenance of common schools and the purchase of suitable libraries therefor, and the residue to the support and maintenance of academies and normal schools, and suitable libraries therefor.

6. The legislation, particularly Sections 1072—1, 1494—43, 1494—61 and 1494—62, providing for use of money raised by taxation for the growth of forests, operations and improvement thereof, for future use, is not a public purpose within §5, Article VIII of the Constitution, limiting exercise of the power of taxation to levies from year to year sufficient to meet state expenses.

7. Neither Section 1072—1, nor any other law of the state, contains, in letter or otherwise, any grant of power to buy land for forestry purposes on credit, giving long time interest bearing obligations therefor.

8. The land contracts in question are evidences of indebtedness and so prohibited by §9, Art. VIII of the constitution, providing that: "No scrip, certificate or other evidence of state indebtedness shall be issued except for such debts as are authorized by the sixth and seventh sections of this article."

9. If the land contracts in question and the forestry system, in general, can be considered as within the field of public use warranting state taxation to support the same, in any event, they are within the prohibition of §8, Art. 10 of the state constitution providing that: "the state shall never contract any debt for works of internal improvement, or be a party in carrying on such works," except in case of lands or other property granted to the state "especially dedicated by the grant to particular works of internal improvement."

10. Section 1092m Stats., attempting to burden the trust fund lands of the state with taxation and thus invade the right of the school fund to the proceeds of such lands, violates the constitution in respect to such matters and violates the rule that the "rule of taxation shall be uniform." §1, Art. VIII, State Constitution.

11. All the appropriations for forest reserve purposes depend

for validity upon the constitutionality of the statutes mentioned and, in the course of the administration of the duties of the office of Secretary of State, he will be called upon to audit claims for money under such statute, dependable for their validity upon questions material to the validity of the claim which gave rise to this litigation, and, therefore, he was and is justified in refusing to obey the command of the alternative writ.

The plaintiff demurred to the answer for insufficiency and the issues thus raised were submitted for decision on all questions suggested by the return.

After the cause was thus submitted, the court, deeming considerable time necessary for study thereof, and that pending the decision, to the end that the final judgment might have the fullest judicial efficiency, the activities of the State Forestry administration should be restrained in the meantime to the necessary work of taking care of the lands of the state, whether held in trust or otherwise, of its own motion entered an order enjoining, until otherwise ordered, the creation of any obligation, in form or in fact, of the state, for the purchase of land under the forest reserve act, or paying out money upon any contract for such lands theretofore made, or selling, or contracting to sell, any lands derived under any grant from the United States which are claimed to have been turned over for Forest Reserve purposes, or any lands purchased for such purposes, or incurring any expense in respect to land claimed to belong to the State for a forest reserve other than such as should be found necessary to protect the same against danger from fires or from being injured by trespassers.

MARSHALL, J. The decision in this case has been delayed very much longer than is usual after submission. That circumstance signifies the Court's conception of the importance of the particular matter. There has been no undue delay. The questions presented and requiring consideration and decision measure up with anything heretofore dealt with here. When the case was submitted we were confronted with these propositions among others:

1. Legislation has been placed on the statute books, causing large expenditures of public money and imminent peril of further such expenditures, in violation of the inhibition against the state contracting "any debt for works of internal improvement or being a party to carrying on such works."

2. The modification of such inhibition purporting to have been adopted in November, 1910, and supposed to permit appropriations of money out of the state treasury "for the purpose of acquiring, preserving and developing the water power and the forests of the state," under which large sums of public moneys have been expended and other such expenditures are imminent, is not a part of the constitution.

3. The legislature in proposing such amendment did not comply with the grant of power in respect to the matter.

4. The particular indebtedness questioned in this case was created pursuant to legislation,

(a) in violation of the inhibition as to internal improvements;
(b) in violation of the constitutional limitation of indebtedness to one hundred thousand dollars;
(c) in violation of the prohibition as to issuance of evidences of indebtedness;
(d) in violation of the constitutional prohibition as to creation of indebtedness except for emergency purposes;
(e) in absence of legislative authority, even in form, to buy land on interest bearing credit.

5. The particular indebtedness is a part of and dependable upon the general scheme contained in sections 1494—43 to 1494—62, inclusive, Stats. setting aside the state trust fund lands and proceeds thereof to be used, with money derived from taxation, to purchase other lands for reforestation and exploitation for general benefit in violation

(a) of the terms of the grant by which such trust lands were acquired from the United States and
(b) in violation of the State Constitution pledging fidelity to the terms of the grant from the United States and setting apart "all moneys arising from any grant to the

state where the purposes of such grant are not specified" for common school and other school purposes.

6. The Legislature, in constructing the forestry scheme, violated the constitutional jurisdiction of the Commissioners of Public Lands over property set aside by the fundamental law for school purposes, wholly ignoring and superseding constitutional limitations in respect to such property.

7. All appropriations for forestry purposes violate the constitutional system limiting all tax burdens to such as are necessary to "defray the expenses of the state."

8. It violates the constitutional system designed to limit all state expenditures to public purposes of a governmental character.

9. So far as within the police power, it violates the constitutional limitation upon the exercise thereof.

10. The legislative plan for burdening the lands in the forest reserve for local taxation purposes, violates the constitutional requirement for uniformity of "rule of taxation," the prohibition of "special legislation for the assessment or collection of taxes," and the right of local self government.

Each of such propositions was so supported as to challenge the most serious attention thereto of representatives of the state and its officers, who, as indicated, were charged with being the legislative instrumentalities for burdening the state with illegal taxation, wrongful diversion and waste of its school funds and property, depletion of its treasury and increase of its indebtedness. It was claimed, and not without reason, as will be seen later, that the trust funds and trust fund lands,—notwithstanding the protection of the state's obligation to the United States and the mandate of the state constitution,—have been inextricably confused with other funds and lands and diverted from their legitimate purpose to such as are entirely foreign thereto, causing loss to such trust funds of thousands of dollars, ignoring their sacred character and entirely imperiling their existence.

There was no other way under the circumstances by which the great interests of the state could be properly conserved, but for the court to exercise in a somewhat extraordinary, but proper way, its power to prevent and redress wrongs, particularly where vital interests of the whole people were imperiled. That was done, as indicated in the statement, by supervising the formation of issues so as to bring all the matters referred to definitely before it upon the record, and by restraining further activity within the alleged scope of illegalities until such time as the real rights involved could be considered and as the result of exhaustive study, be determined. We should say, in passing, that the state officers who now are the commissioners of public lands, were not adversary to having such questions thus presented for solution, but rather were favorable thereto and co-operated in having the right of the matter vindicated.

It is believed that the situation sought, as stated, to be reached by the court, has been attained as nearly as can be under the circumstances. That some diversity of views should exist where so many important far-reaching questions are involved, having to do with a long practice, developed through legislative promotion from a small beginning to the state indicated, is unavoidable. Happily there is practical unanimity on the generality of questions which we must answer. They will be taken up in the order which seems best suited to the case, though quite out of that seen in the statement, which follows more closely the presentation by counsel.

I.

Is the second proviso to section 10, Article VIII of the constitution, purporting to so modify the original general disability of the state as to internal improvements, so, as is supposed, to authorize state appropriations and expenditures for "acquiring, preserving and developing the water power and forests of the state."—a part of the fundamental law?

The principles applicable to the stated question are so fully set forth in State of Wisconsin ex rel. Fred Postel vs. Ben Marcus, decided January 12th, 1915, it is sufficient to refer thereto, restricting the treatment here, in the main, to a statement of the facts.

The joint resolution which resulted in the proviso above mentioned appearing in the official publications as part of the state constitution, was introduced in the Senate at the 1907 session. The only notation on the Senate Journal at first is this:

"Jt. Res. No. 43 S.

"Providing for an amendment to section 10 of Art. VIII of the constitution relating to internal improvements."

"*Resolved by the Senate, the Assembly concurring,* That section 10 of Article VIII of the constitution be amended by adding at the end of said section the following: 'Provided that the state may appropriate money for the purpose of acquiring, preserving and developing the water power and the forests of the state.' " S. J. 674.

That is identical, so far as it goes, with the language finally written into the constitution; but, sometime during the proceedings in the legislature, this was added without being spread on the Journal either by itself or as a part of an entire proposal: "But there shall not be appropriated under the authority of this section in any one year, an amount to exceed two-tenths of one mill of the taxable property of the state as determined by the last preceding assessment."

Thus the possible burden per year for the new activity was restrained to about $500,000, according to existing conditions, with progressive probabilities which, in time, might reach a much larger amount.

In due course, a substitute was proposed which was not entered on the Senate Journal. (S. J. 1049).

Later, a second substitute was proposed, (S. J. 1119). It was not entered on the Journal.

The second substitute was adopted. (S. J. 1134). It was not, at any time, entered upon the journal of either house in extenso or by title.

After adoption of such substitute, substitute No. 1, was withdrawn and the resolution was passed without Journal entry as to its final form. (S. J. 1134).

The action of the Senate was, in due course, reported to the Assembly and the resolution was entered on the Journal by its number and origin without any indication of its import. (A. J. 1298).

Later, without reference to any committee, the Senate resolution was concurred in; no journal entry being made other than of the vote, except this: "Jt. Res. No. 43 S., providing for an amendment to Section 10 of Art. VIII of the Constitution relating to internal improvements."

At the legislative session of 1909, an attempt was made to submit the proposition of 1907 in the Senate by Joint Resolution 33 S., and in the Assembly by Jt. Res. 38 A.

The resolution as entered on the Senate Journal purports to embody the action of the previous session and includes Section 10 of Art. VIII as it would appear if amended as proposed. It omitted the earlier change relating to highways, making a very different proposal than that of the previous session.

In due course, Jt. Res. 33 S. came before the Senate for action upon a substitute which was adopted, and in its new form the resolution was passed. (S. J. 731).

What the nature of the substitute was is not disclosed by the Journal. The only reference to the matter after the resolution was introduced, is by number. The actual title, from first to last, is this: "A Joint Resolution purporting to amend the constitution, permitting the state to appropriate money in excess of $100,000 for the purpose of acquiring and developing water powers and forests of the State." Quite different, as will be seen, from the resolution as introduced at the 1907 session.

In due course, the Senate Resolution was received by the Assembly, but no Journal entry was made indicating its purport. (A. J. 842). After the several steps had been taken without any more expressive Journal entry, the resolution was ordered "held at the clerk's desk for reference to the special committee on waterways to be appointed." (A. J. 1009). Such committee was in contemplation, as what follows will indicate. The clerk's endorsements on the resolution agree with the journal entries. The last is this: "Referred to special committee to be appointed by the Speaker for the special session."

May 1st, 1909, a Joint Resolution was adopted providing for a committee to consider several matters and report at a special session which was in contemplation. In general scope, they included the subject of Joint Resolution 33 S. and Jt. Res. 38 A. Both were referred accordingly. The committee was not appointed. The contemplated session did not occur. Thus both the resolutions dropped out of sight.

In anticipation of the adoption of Jt. Res. 33 S., Bill 583 S. was introduced, providing, as usual, for submission of the proposed amendment to a vote of the electors. The bill erroneously recited that the proposal had already been agreed to by the Senate and Assembly. It was passed in the Senate May 25th, 1909, and concurred in by the Assembly June 9th, 1909. There was no yea and nay vote nor record showing by what vote the matter was passed in either house. In due course, it became Chapter 514, Laws of 1909.

It is thought that no discussion is necessary for the purpose of demonstrating that the facts detailed come far short of satisfying the requirement of Section 1, Art. XII of the constitution conferring upon the legislature the ministerial power to formulate proposed amendments to the constitution. The proposal, as agreed to, at the first session was not, in any sense, entered on the journals of the two houses. At the second session it was not entered on the Senate Journal nor on the Assembly Journal, nor was it agreed to by the Assembly. Such journal entries, at the second session, though advisable, were not vital, as held in *State ex rel. Postel vs. Marcus,* decided January 12th, 1915.

The failure by the Assembly to concur in the Senate Resolution was not, by any means, cured by its concurring in Bill 553, S. That did not purport to pass on the resolution. It proceeded regardless of the condition thereof. The fact that it was not passed by a recorded yea and nay vote in either house, of itself, leaves no fair basis, from any viewpoint, for holding that it supplies the place of an express approval of the proposal to amend.

Testing the foregoing by *State &c. vs. Timme,* 54 Wis. 318: "No amendments can be made under this section without a compliance with all its provisions both in the passage in the legislature and the submission to the people," fatal infirmity is easily seen.

If all else could be successfully passed by in this case, the fact that the proposal was not passed upon, at all, in the Assembly at the session of 1909 would be insurmountable. Such an effort, as in the case heretofore decided, to be efficient must be characterized, among other things, by these circumstances:

The proposal must be acted upon favorably by a majority of the members elected to each house, evidenced by a recorded yea and nay vote.

As agreed to at the first session, it must appear upon the journal of each of the two houses. At the next session of the legislature each of the two houses must agree to the precise proposal agreed to at the previous session, and that must be evidenced by a recorded yea and nay vote in each house.

We may well add that, Senate Resolution 33 aforesaid, was not published as having been agreed to. How it came about does not appear; but the fact is that Assembly Resolution 38 was published, which never passed out of the Assembly and was referred, as before indicated. The executive officers of the state have, in several ways, treated the proposed amendment as not adopted. It was not published in the Laws of 1909. The legislature of 1911, inferentially, declared the previous proceedings void by commencing anew to change the constitution substantially as before. (p. 1386, Laws of 1911). The Legislature of 1913, likewise passed upon the matter by making a third attempt to so amend the constitution. (Laws of 1913, p. 1120).

Therefore it is considered that the second proviso to Section 10 of Art. VIII of the Constitution, as printed in the official publication, is no part thereof and does not furnish any support for the proceedings called in question in this case. So far as such proceedings and others concerning the administrative acts of acquiring and using lands for the development of forests and water powers and legislation in respect thereto are within the constitutional scope of "works of internal improvement," they must be declared void.

We think proper to remark as of public interest, that it is a mistake to suppose the judicial disapproval of a legislative effort to propose a constitutional amendment to the people, as in *State &c. vs. Marcus,* supra and here, is based on what is commonly termed in legal matters "technicalities." It is very far therefrom. Those who assume to teach on this subject should be very careful not to inculcate false notions in respect to such an important matter. To characterize the point that there has been a failure to do a thing which the people made a condition precedent to efficiency of the particular activity of amending the constitution, a technicality, shows want of appreciation of the very basic features of a constitutional system and, unwittingly, breeds disrespect for such a system, if not for law in general. The court does not accord any dignity to mere technical accuracy in respect to non-essentials, and none in any situation unless required by mandate of written law. But the court is in duty bound to decide upon what is technical or directory, and what is substantial and mandatory. What the people in creating our form of government made material, no one has a right to say is not, or is technical, in the common acceptation of that term as being mere matter of form. The court cannot so invade the sovereign command unless its trusted instrumentalities violate the solemn obligations to which they are pledged by their oaths of office.

II.

Is the indebtedness created for purchase of land for reforestation and water power purposes within the constitutional prohibition contained in Sec. 4, Art. VIII of the constitution, providing that "The State shall never contract any public debt except in the cases and manner herein provided"?

Little time need be spent in answering that question. For the purpose thereof we will assume for now, without deciding, that the State Forester has authority to sign the corporate name of the "State of Wisconsin", by himself, as its authorized officer.

The obligations to pay for the contract lands may be, at this point, considered, apart from the evidence of it. If any authority existed to purchase land, obviously, the agreement to pay in consideration of the agreement to sell, which characterized all the actions of the State Forester in the purchase of land, created indebtedness.

There is nothing particularly technical about the meaning of the word "debt" as used in the constitution. It includes all absolute obligations to pay money, or its equivalent, from funds to be provided, as distinguished from money presently available or in process of collection and so treatable as in hand. *Earle vs. Wells,* 94 Wis. 285; *Dow Township vs. Channing,* 142 U. S. 366, 376.

There was an unqualified promise to pay in all the land purchase transactions. The character of each was the same as that of any ordinary binding promise to pay in consideration of a promise to sell and convey the agreed equivalent. They were not grounded on money presently, or its equivalent, available for their discharge, but upon anticipated means to be derived from state appropriations running years into the future, and proceeds derivable from state property. That the promise to pay, so far as any competency existed, created state indebtedness, does not seem to admit of a question.

III.

Is the indebtedness, so-called, incurred, within the exception of the prohibited competency mentioned in Section 4?

The language of such exception is very precise and its meaning unmistakable. "The cases and manner herein provided" requires us to find express authority to create such as that in question and to create it in the particular manner attempted. The only purpose specified as within the exception is found in Sections 6 and 7 of Article VIII of the Constitution, as follows:

> "For the purpose of defraying extraordinary expenditures the state may contract public debts (but such debts shall never in the aggregate exceed one hundred thousand dollars). Every such debt shall be authorized by law, for some purpose or purposes to be distinctly specified therein; and the vote of the majority of all the members elected to each house, to be taken by yeas and nays, shall be necessary to the passage of such law; and every such law shall provide for levying an annual tax sufficient to pay the annual interest of such debt and the principal within five years from the passage of such law, and shall specially appropriate the proceeds of such taxes to the payment of such principal and interest; and such appropriation shall not be repealed, nor the taxes be postponed or diminished, until the principal and interest of such debt shall have been wholly paid.
>
> "The legislature may also borrow money to repel invasion, suppress insurrection, or defend the state in time of war; but the money thus raised shall be applied exclusively to the object for which the loan was authorized, or to the repayment of the debt thereby created."

It would seem that little, if anything, need be said to demonstrate that the obligations, aggregating some $230,000 in all, and undischarged to the extent of some $130,817.35 when this action was commenced, answer to the constitutional meaning of "public debt" and do not answer to its call for exceptional cases for incurring such debts or for manner in respect thereto. The particular infirmities are too clear to require being pointed out.

There was no option feature about the purchase agreements, as in *Burnham vs. Milwaukee*, 98 Wis. 128, and *Stedman vs. Berlin*, 97 Wis. 505. The absolute liability was not contingent upon some future occurrence, as in *Herndon vs. Oconto*, 110 Wis. 660; *Town of Vaughn vs. Town of Montreal*, 124 Wis. 302. Payment was not made dependable upon particular funds, as in *Brown vs. Ringdahl*, 109 Minn., nor appropriations without incurring any indebtedness *in praesenti*, as in *Fleckstein vs. Lamburtón*, 69 Minn. 187.

Much time might be spent in reviewing the numerous cases, brought, by the industry of counsel, to our attention. It may well be admitted that courts have been quite, and perhaps too, resourceful in discovering methods of so construing the term "debts" and "indebtedness" as to restrict the meaning thereof so as to meet the exigencies of particular cases. The safest way is to cut quite loose from case law and look to the fair meaning of the constitution itself. To study the many judicial sayings and endeavor to evolve a rule of unwritten law therefrom would be liable to impair the constitutional mandate and add to the confusion which I think already exists. This court, in the public utility and option cases, has given as broad a meaning to the constitution as can well be accorded thereto. These agreements come far short of satisfying the logic of those cases. They are absolute promises to pay sums of money, fixed as to amount, *in praesenti*, with payments deferred and without reference to money in hand or equivalent.

IV.

Are the obligations, in form, within the prohibition of §9, Art. VIII of the constitution providing that "No scrip, certificate, or other evidence of state debt whatsoever, shall be issued except for such debts as are authorized by the sixth and seventh sections of this article"?

What has been said under the previous head sufficiently answers this question. Obviously, the excepted indebtedness for which evidences may be issued do not include such as that in question, as we have seen. Given the premises, that the promise to pay created a state debt and that such debt was within the prohibition of §4, aforesaid, of the constitution and it follows, logically, and conclusively, that the written contracts embodying promises, as is ordinarily the case, *inter partes,* where there is mutuality of absolute obligations, are "evidences of state debt" in the constitutional sense of the term.

It will not do to restrict the meaning of "evidences of state debt" to municipal bonds or other similar obligations, because, impliedly, Sections 6 and 7 refer to debts, commonly and well nigh universally, evidenced by such obligations. The clause is in words of limitation respecting the manner in which the state may become indebted. The prohibition in the later section harmonizes with that in Sec. 4 and the exceptions in sections 6 and 7, and is so phrased as to leave no possible room for construction, "no evidence of state debt whatsoever" is permissible except for the particular purpose mentioned in Sections 6 and 7.

V.

Were it not for infirmities in the land purchase agreements, assuming for now that Chapter 639, Laws of 1911 (§1072–1 Stats.), is constitutional, is the particular agreement which gave rise to this litigation,—the Sanborn contract so-called,—one authorized thereby? The enactment, in terms, appropriated $50,000 per year for a period of five years and the interest thereon as a forestry investment fund, authorized the state forester, under the supervision of the State Board of Forestry to contract for the purchase of land as an addition to the forest reserve, and to pay therefor out of the forest reserve fund as moneys became available. Under this and other sections very broad powers were attempted to be given to the officer, called State Forester. A legislative creation removed from control of any of the constitutional departments of the state, by jurisdiction as to competency of the active officer being conferred upon a minor United States official and his selection, subject to such jurisdiction, being placed with a board, called the State Board of Forestry, made up of five members, three not officers of the State, one constitutional officer and one appointee of the Governor—was substantially given all powers formerly exercised by the Commissioners of Public Lands named in the constitution—the Secretary of State, the Attorney General and the State Treasurer; and large additional powers were conferred upon such officer under the supervision of the practically non-official board, no one except the Attorney General being responsible directly to the people. Such officer, so clothed with large powers was not required to be a citizen of the State or give bonds, as in ordinary cases to secure fidelity to his trust. This situation is not referred to in criticism of the public policy evinced thereby, but as throwing some light on the probability of whether the legislature purposed by the statute under consideration to confer upon the state forester the extraordinary authority to sign the corporate name of the state to contracts of the nature of those under consideration. They might have run up to a very large amount,—hundreds of thousands of dollars,—two hundred and fifty thousand referable to the particular piece of legislation. The contracts though signed by the State of Wisconsin, do not contain any personal signature except that of the state forester and the president of the state university in his capacity as chairman of the Board of Forestry.

The extraordinary authority thus assumed would, of itself, suggest ambiguity in the legislation calling for construction, if it were plain in its letter. It is not altogether plain. One would expect to see authority of the large nature suggested conferred, if at all, even upon constitutional officers of the state, clothed in plain unmistakable language. *A fortiori*, when conferred upon a legislative creation the selection of which was practically surrendered to an outside agency and a non-official class, not answerable to the people and not under bonds for fidelity to the trust.

We are unable to find authority, even in form, conferred to make such contracts as those in question,—long time interest bearing absolute obligations to pay. An investment fund was contemplated and payment out of that as available, which might be cut off at any session of the legislature. It is quite significant that the Forester by the terms of the act was to contract for lands payable out of the investment fund as available, not payable in fixed sums and at stipulated times with interest. The fund was denominated an investment fund and language was used, showing, unmistakably, that it was expected to be augmented by interest, in striking contrast with the idea of using the fund for payment of large sums of accrued interest on land purchase obligations.

The question of whether the Sanborn contract, dated June 1st, 1911, in fact, antedated the Act of 1911 which was approved July 11, 1911, was argued at considerable length. There are some reasons for holding in the affirmative and some for a contrary view. As we have already seen, and shall see further, if this point were important in any event, it is so overshadowed by other features of the case as to practically drop out of sight. We will dispose of the point on the assumption that the indebtedness on the Sanborn contract of $90,076.11, originated after the act of 1911 became in force, notwithstanding the conflict as to dates. Most of the contracts in number and also in amount, if we consider the Sanborn contract as indicated, making up the entire amount around $200,000 of indebtedness contracted, were made after the act of 1911 took effect. Nothing in the foregoing should be taken as casting any reflection upon the incumbent of the office of State Forester. Nothing which we have perceived in this case casts the slightest discredit on him personally. On the contrary, there are many evidences of most distinguished devotion to the legislative duties he was employed to perform.

VI.

If by any possibility we were mistaken in our conclusions up to this point, we would then face this question: In making the land purchase contracts was § 6, Art. VIII of the Constitution violated as to the feature limiting state indebtedness to one hundred thousand dollars?

We see no way of escape from the conclusion that such question must be answered in the affirmative. The statement of facts plainly shows this: The purchase contracts themselves far exceeded the constitutional limit. True, the limit, looking only to such contracts, was not reached by the Sanborn contract, but the State was indebted, in fact, at the time of making the first contract in a sum exceeding two million dollars. As indicated in the statement, it was mostly incurred during the Civil War and to defray cost of constructing the state capitol and hospital for the insane; some being borrowed, so-called, direct from the trust funds of the state, and some by issuing obligations in the shape of bonds and other evidences of indebtedness. None of this was, really, ever paid. The evidences of debt were taken out of circulation, so far as any reached that stage, by the commissioners of public lands as an investment for trust funds under legislative authorization, in form. All was used for legitimate state purposes and, doubtless, the state is morally and equitably liable to make the trust fund good, and it has done so up to date by paying interest on the indebtedness out of the proceeds of tax burdens, contrary to the constitutional plan. The state is liable to make good the misuse the same as any trustee is responsible for money entrusted to his care. Whether the state is remediably so liable, does not matter for the purposes of this case. It has always recognized liability by maintaining outstanding interest bearing evidences of debt, made in due form, as between borrower and lender, and, doubtless, will continue to do so without interference from any source, until some efficient plan shall have been adopted and executed for their retirement.

Had the trustees asserted their constitutional power when they might have done so, they could have preserved their trust inviolate in spite of legislative direction. Had forces been seasonably put in motion to redress departure from the legal course it would have been somewhat troublesome to them and their sureties notwithstanding they were so morally innocent.

It is very plain that the constitution made the three constitutional officers a Board of Commissioners for the administration of the university and school lands and the funds derived therefrom. § 7, Art. X of the Constitution. That provided for the sale of all such lands. All, until within recent years, as regards sales and protection of lands, was administered under such provisions. The board was made an independent entity, substantially an artificial person like a corporation, referable for its authority solely to the fundamental law, except as to some particulars, and not to the legislature. The latter possessed power for the purpose of conservation of the trust, but no power to breach it, or afford authority to the constitutional board to do so. The only way the state, if it were not for disability as to restrictive use of the trust fund and as to incurring indebtedness, could properly obtain any part thereof for general governmental purposes, is by creating the relation of debtor and creditor.

The policy pursued by the state during the distressing conditions existing during the Civil War, it is not our business at this late day to criticise. The emergency was one of that overshadowing character which, sometimes is supposed to excuse, if not justify, a breach of some feature of the fundamental law for the purpose of saving the sovereignty which created it. But that does not militate against the fact that some over $2,000,000 of state certificates of indebtedness held by the constitutional board of trustees of state trust funds, stand for indebtedness in fact, the same as if the money had been borrowed in the ordinary way.

The fact that the money so obtained has been returned to the state, principal and interest, to the extent of $2,257,291.74, or thereabouts, does not change the situation. It has never been returned to the trust fund. The history of this is strange, " 'tis passing strange," but involves no moral turpitude. It demonstrates, however, how prone the people are, unless restrained by a strong arm, to leap over the very barriers they have created for their own protection.

Of the original indebtedness to the trust funds, there stands the $100,000 of the bonded indebtedness for the State Capitol and Hospital for the Insane, incurred in 1862 and 1863, taken by the Board of Commissioners of the trust funds as an investment and so remaining. That, of itself, was enough to exhaust the capacity of the state to borrow money. Again, the indebtedness to the trust fund includes several hundred thousand dollars borrowed by the state and used for general state purposes. As indicated, why the large sums paid to the state to reimburse it for the trust fund depletion were not returned thereto, is not our business. The fact, though, is important here that, notwithstanding payment to the representatives of the state of $2,257,291.74, none of it reached the trust funds. It was used for general state purposes and to lighten the burden of taxation. Whatever wrong is thus involved the constitutional elective officers of the state, legislative and executive, except the justices of this court, have been to some extent participants therein with passive consent of the people and without moral turpitude and without, in a technical sense, any financial loss to the state, assuming that it obtained value received for its expenditures. But the real test of what is wrong, in an ethical sense, does not rest in whether there is injury nor whether the transgression is remediable.

As before indicated, though we thought it proper to indulge in the observations above, we appreciate that the policy involved in the past of handling of the trust funds as regards the use thereof as a source from which to borrow by the state is a matter we have nothing to do with in this case, except as it incidentally throws light on the character of the certificates of indebtedness we have discussed.

If this case so brings to public attention such real character as to cause greater fidelity in the future to the great trust created by the constitution and stimulate, to effect, remediable measures for the past, it will have served a monumental purpose. For now, suffice it to say, that the certificates of indebtedness of the state held by the Board of Commissioners of School and University lands represent state debts, within the meaning of §6, Art. VIII of the Constitution, and no act of the Legislature can properly change that situation. The school and university trust funds are high above the competency of the legislature to destructively assault them.

VII.

This further question is presented as overshadowing all heretofore treated as regards the land purchase agreements, and, as counsel for defendant claim, strikes at the very foundation of the legislative scheme of which the law of 1911 is a part and is supposed, by the state agencies, to specially authorize such agreements if no authority existed before.

Does the forest reserve scheme provided for by § 1072—1 Stats. (Ch. 639, Laws of 1911) and §§1494—41 to 1494—62, inclusive, contemplate state participation in works of internal improvement, within the meaning of § 10, Art. VIII of the State Constitution?

To such extent as the stated question must be answered in the affirmative, such scheme must fall under the condemnation of the fundamental law, since the legislative effort to amend it failed, as we have seen.

What are "works of internal improvement," in a constitutional sense, would admit of differences of opinion as an original proposition. If it be confined to the particular kind of improvements which moved the framers of the constitution to make the broad prohibition a part of the fundamental law, it means one and a somewhat narrow thing. If it was a principle the constitution makers had in view, and not particular activities within the scope of such principle, it means quite another and covers a very broad field.

It will be instructive to look at the matter under consideration from the various viewpoints. If the line of sight from each of the points of view leads to the same result, the conclusion which should be pronounced will stand upon pretty solid ground.

(The Legislative View.)

By attempts to amend the constitution so as to cover the subject, as we have seen, the legislature most considerately, consistently and persistently treated reforestation as involving a work of internal improvement. Not only at one session but at three, it was so treated. By two joint resolutions in 1907, two more in 1909 and bill 553 S., the subject was referred to as "relating to internal improvements." The "appropriation of money for acquiring and developing water powers and forests" was likewise made referable thereto. The final act, as before stated under another head, embodied in Chapter 514 laws of 1909 bears this title: "An act to submit to the people an amendment to Sec. 10, Art. VIII of the constitution relating to internal improvements." There we have the legislative conception of the joint resolution which failed; entitled as a proposal to authorize appropriation "of more than $100,000, for acquiring and developing water powers and forests." Referring more particularly to the legislative construction, the legislature of 1911 by the new attempt to accomplish that which failed before, labelled the resolution "To amend Section 10 of Article VIII of the constitution, relating to internal improvements." Laws of 1911, P. 1121. The repetition was by a still broader proposition bearing the same label in the legislature of 1913, Laws of 1913, P. 1386. Those efforts at four sessions to embody in the constitution authority to appropriate money for internal improvements of the character specified therein, viz: "acquiring, preserving and developing the water powers and forests of the state" as phrased at first; "permitting the state to appropriate money in excess of $100,000 for the purpose of acquiring and developing water powers and forests of the state'' later; then: ''Providing that the state may appropriate moneys for the purpose of acquiring, preserving and developing the water power resources and forests of the state,'' and lastly: ''to regulate or improve the navigable waters and streams of the state, and to acquire, preserve, regulate or develop the water supply, water powers, lands and forests of the state''—make about as strong a case respecting the legislative idea of whether the particular activities under consideration are ''works of internal improvement'' as circumstances could create.

It will be observed that the various phrasings of what was in the legislative mind check up with the language found in some parts of the reforestation scheme and with the spirit of the whole.

True, the legislative idea does not settle the matter at issue. While it shows the legislative intent, pretty conclusively, what meaning the framers of the constitution intended to convey by the term ''internal improvements'' might be more restrictive. We must recognize that it is the latter which is the subject for discovery. It may be that the forest reserve scheme, to some or much extent, is legitimate, yet that its promoters persuaded the law makers to go so far that the very magnitude of the undertaking as it developed aroused appreciation of a probable constitutional peril, leading to the strenuous efforts indicated to guard against it by the fundamental law, in its letter, according to legislative interpretation covering the subject favorably to the enterprise.

(Former Judicial View Here.)

We note that counsel for plaintiff recognize that the words of the constitution must be accorded the meaning its framers attributed thereto, though some other reasonable meaning might be gathered therefrom if we were not thus restricted. That is a cardinal rule of construction which we will refer to on another branch of the case.

A further concession of counsel we must accept as sound. That is, that if the words "internal improvements" are to have a broad general meaning they must be held to include the use of public money for the purchase of lands and the preservation and development of water powers and forests thereon and much of the activities contemplated by the forestry scheme. In that connection it is confidently suggested that "the broad and general meaning being an impossible one the restrictive meaning in which the words must, necessarily, have been used is the thing to be sought for."

If it were true that, "the broad and general meaning is an impossible one"; the conclusion of counsel would appear very plausible. It seems that taking the whole of counsel's reasoning it is illogical and the conclusion a non sequitur. If the premise in the latter part were accepted as a verity, the conclusion would be quite clearly correct. But what right have we to assume that "the broad general meaning is impossible?" If that be correct, or if the words must "necessarily have been used in the restricted sense" of referring to some particular species of "internal improvements" instead of to declare a principle of general application, then this court must have made a serious mistake in the line of logic adopted and the conclusion reached in *State ex rel. Jones vs. Froelich,* 115 Wis. 32, and other courts have made a like mistake as we shall see.

The case to which we refer did not escape the attention of counsel. But it seems they did not get the right idea out of it. It did not deal with any such internal improvements as "channels of trade and commerce" which is thought to be the restrictive meaning of the term "internal improvements" now contended for. It applied the "broad general meaning" which is now said to be "impossible" to include the particular enterprise. It was conceded that the particular matters were what had challenged the attention of the members of the constitutional convention and that the question was whether their view was thus restricted in guarding against dangers to the prospective new state. We cannot do better now than to adopt the course of reasoning which then led to a unanimous conclusion. That conclusion must be followed now or be overruled. The fact, if it be a fact, that such result will or may lead to some embarrassment in respect to other enterprises which the state has entered upon at public expense, can make no difference. The constitution must be upheld at all hazards until the people who made it see fit to change it. It is not likely that they would sanction large general taxation which cannot, in the very nature of things, come home to them, individually, if they had an opportunity to pass on the matter directly. A constitution would be of little protection to the people against their representatives who might for a time lose sight of the wise limitations of the fundamental law, if the very result of the infraction could be successfully held up to intimidate those who are charged with the duty of rectifying the mischief.

The calamities which had befallen the people of neighboring and near-by states from the creation of debts and burdens of taxation for "works of internal improvement," had made a deep impression upon the people of the territory before the selection of delegates to formulate a constitution for the prospective new state. How to avoid the mischiefs which had so befallen the people of other communities was regarded as one of the greatest problems to be solved. The difficulties to be overcome and the fears that they might not be successfully met, constituted a powerful deterrent to the formation of a new government and surrender of the advantages of the territorial organization. No halfway work would satisfy, as will be seen, so as to insure adoption of the work of the convention by the people. That was well understood. Imbued with that sentiment, the constitutional convention of 1846 approached consideration of the subject. A committee was appointed upon the particular matter. From the beginning to the end, there was no lessening of the determination to encompass the matter in hand effectually if possible. The committee's report was one of the first to come before the convention. It was as follows: "Internal improvements shall forever be encouraged by the government of this state. But the legislature shall, in no case, create or incur a state debt for that object, without at the same time providing means for payment of interest thereof and final liquidation of the same.''

That proved very unsatisfactory. Methods of strengthening the prohibition were suggested and on motion of Hon. E. G. Ryan the whole matter was referred to a special committee of seven. He was made its chairman. In due course, the committee reported this: ''Section 1. The state shall encourage internal improvements by individuals, associations and corporations, but shall not carry on, or be a party to carrying on, any work of internal improvement, except in cases authorized by the second section of this article.''

''Section 2. When grants of land or other property shall have been made to the state, specially dedicated by the grant to particular works of internal improvement, the state may carry on such particular works, and shall devote thereto the avails of such grants so dedicated thereto; but shall in no case pledge the faith or credit of the state or incur any debt or liability for such works of internal improvement.''

''Section 3. All lands which come to the state by forfeiture or escheat, or by grant, where the grant does not specially dedicate the same to any other object, shall be held by the state as part of the state school fund, under the same trusts, reservations and restrictions as are provided in this constitution in regard to school lands proper.''

We shall later recur to this last and very significant section on another branch of the case.

The unqualified, unmistakable character of the effort of the Ryan Committee is about what one would naturally expect to come from the hands of its distinguished head. It left no room for construction, as was doubtless thought. The reference thereto in the second convention, is convincing evidence of that. What was aimed at was the declaration of a principle as broad as plain English words could make it. The recommendation without change became a part of the proposed constitution.

The only possible weakness in the proposal thus submitted to the people was the pledge of state encouragement of internal improvements. The fear was that through such avenue some way would be found to use state revenues and state property for other than ordinary state purposes. However, the proposal was, in general, approved though the constitution as a whole was disapproved and, of course, the particular proposal went with the rest; though it furnished the model for guidance in the second convention.

There was still a deep seated fear that insecurity lurked in the move to form a new government and the people demanded to be convinced of the contrary and to that task the second convention bent all its energies, proceeding by the light of the former experience. The favor with which the particular clause was received before was referred to in the convention, frequently, and was given much significance by this court in *Jones &c. v. Froelich, supra,* as indicating, pretty clearly, that the principle of exclusive individual and local communal instead of state enterprise was the thing the framers of the constitution had in mind and not any particular class of internal improvements.

Speaking of the history of the subject in the second convention this court before said:

> "In the convention of 1847 * * * the clause from the former which directed encouragement of internal improvements by private enterprise was at first reported but afterwards dropped out, and that prohibiting the incurring of any indebtedness therefor was inserted. The debates make it entirely clear, however, that the choice made was between the policy of permitting governmental construction of 'internal improvements' and that of leaving them to come by private enterprise. The same choice was obvious in Michigan when in 1850 the people reversed the policy commanded by the constitution of 1835 and adopted a prohibitory section substantially like our own. * * *
>
> There cannot be doubt that this quarter century of vehement discussion had produced a fairly definite conception of what had come to be designated 'internal improvements,' which either the government was to undertake, or was to leave to private enterprise, according as one policy or the other prevailed. We think it clear that such conception included those things which ordinarily might, in human experience, be expected to be undertaken

for profit or benefit to the property interests of private promoters, as distinguished from those other things which primarily and preponderantly facilitate the essential functions of government. Of course, this line of classification does not exclude possibility that the dominant characteristics of one class may be present in illustrations of the other. A toll-earning canal which gathers spreading water within its banks may promote public health, as also may a drainage system undertaken for improvement of the lands of those who construct it. Improvement of the grounds of a state institution may improve access to, and enhance the value of, private property. But in each case the dominant purpose is obvious, and therefore the classification along the line of distinction above stated."

The idea that the constitutional conception of the term "works of internal improvement" was restrictive in character, and included only avenues of travel and commerce upon which the calamitous expenditure of public state money had been made elsewhere, and so had imperiled the welfare of the older states, was repudiated in the light of the times in which the constitution was framed, the proceedings in respect thereto, and authority elsewhere to which we will specially refer.

The following were pointed to as illustrating the broad character of the term under discussion: Dredging sand flats from a river; deepening and straightening a river; constructing a street railway; telephone and telegraph lines; irrigation reservoirs, roads, highways, bridges, ferries, streets, sidewalks, pavements, wharves, levees, drains, waterworks, improvement of Fox River have been held to be internal improvements. It was said that, whether a particular enterprise answers to the call for a public purpose, is not the test of whether it is outside the constitutional prohibition; that many matters so answer and on that account power in respect to them may be delegated to governmental subdivisions of the state; but such public enterprises are not governmental in character and may be undertaken by private enterprise though having some measure of governmental purpose and, so, are works of internal improvement in a constitutional sense.

The result was that the court held that an appropriation of money for the purpose of constructing and strengthening the levee system so as to prevent the waters of the Wisconsin River from escaping from its banks, is a "work of internal improvement" prohibited by the constitution, notwithstanding the purpose was very much of public character.

After quoting with unqualified approval the decision of the Supreme Court of Minnesota, which we will repeat later, this was declared as the principle to be observed:

"In the light of the historical situation surrounding the framing of the constitution, and the construction, both practical and judicial, since given, we cannot doubt that, prima facie, levees or dikes to restrain the waters of a navigable river are works of internal improvement, within the meaning of the prohibited section * * * and that, too, whether the main purpose be promotion of navigability, creation of water power, or reclamation of adjoining lands. In any of these there is enough of pecuniary benefit to warrant belief in the possibility, at least, that they may be undertaken by private enterprise or local associations."

We note how, *ex industria,* the court attempted to give the broadest meaning reasonable to the particular term, "warranting belief in the possibility at least" that they might be the subject of enterprise other than that of a state character at state expense. Note also the emphasis put before upon the practical construction which had been given in this state to the constitution for half a century, in that nothing in the nature of "works of internal improvement," in the broad meaning of the term, had, up to that time, been undertaken at state expense.

(Judicial Construction Elsewhere which this Court, as above stated, approved.)

As stated in the Jones case, Minnesota, Michigan and some other states followed the policy adopted here and under the same conditions. That particular fact gives significance to the position of this court, since the meaning of the particular term, whether broad or narrow, is governed very much by the characterizing circumstances of its use at the start in the particular locality under consideration, as we have heretofore said, approving of the contention of counsel for plaintiff on that subject.

The particular states mentioned, as a result of a contest the same as here, even discountenanced state interference at state expense in matters of internal improvements to the extent of pledging all lands and money appropriated to the state by the United States for internal improvements, to school purposes, so far as Congress would consent, and so dedicated all other granted lands where free to be so appropriated. That was intended to reach the swamp lands, as we shall see later in treating another branch of the case. It is only referred to now to show the scrupulous care exercised by the framers of the constitution to leave no avenue of escape from the sweeping prohibition.

After the change in Michigan from a policy of state engagement in "works of internal improvement" which occurred in 1850, by substituting in lieu of the constitutional provision for state appropriation for such purposes a prohibition the same as ours, the new policy was vitalized, very greatly, by the court's construing it strictly in favor of the prohibition, instead of as before construing the grant broadly in favor of the power. That will be seen by an examination of the following: *Ryerson vs. Utley,* 16 Mich. 270; *People vs. Town Board &c.,* 25 Mich. 152; *Sparrow vs. Commissioners of Land Office,* 56 Mich. 567; *Wilcox vs. Paddock &c.,* 65 Mich. 23.

Campbell, J., in *Sparrow vs. Commissioners, &c.* speaking of the prohibition said: "The change is as broad as language can make it. It can make no difference for what direct purpose of public utility an improvement is made so long as it comes within such a definition." In *People vs. Town Board,* it was said: that if a work is "directed, planned and executed by state agency" although not at state expense it is within the prohibition.

The clause of the Minnesota constitution as adopted from here is as follows: "The state shall never contract any debts for works of internal improvement or be a party to carrying on such works.''

In *Rippe vs. Becker,* 56 Minn. 100, 117, the precise question we now have under consideration was carefully considered. As we have heretofore said the result there was fully approved here. The opinion of the Court, written by MITCHELL, C. J., is well abridged, as to the principle declared, in the syllabus:

> '' 'Works of internal improvement,' as used in the constitution, means, not merely the construction or improvement of channels of trade and commerce, but any kind of public works, except those used by and for the state in performance of its governmental functions, such as a State Capitol, State University, Penitentiaries, Reformatories, Asylums, Quarantine Buildings, and the like, for the purposes of education, the prevention of crime, charity, the preservation of public health, furnishing accommodations for the transaction of public business by state officers, and other like recognized functions of state government.''

The Minnesota Court, and this court also in *Jones v. Froelich,* said, the term ''works of internal improvement'' in the constitutional sense, is far reaching,—extending far beyond construction or improvement of roads of various sorts, of canals, improvement of rivers and other facilities for trade and commerce. Said MITCHELL, C. J.:

> ''It excludes only such public works as are used by the state in carrying on the affairs of civil government. * * * The far reaching consequences of restricting this constitutional inhibition to highways for travel and commerce * * * would leave the state * * * at liberty * * * to embark in any sort of enterprise outside of its legitimate governmental function, which might be deemed of public benefit. It would admit of * * * engaging in schemes of drainage, irrigation, developing water powers, building public grist mills, public creameries and cheese factories, establishing stock yards and other like enterprises. * * * The time was when the policy was to confine the functions of government to limits strictly necessary to secure enjoyment of life, liberty and property. The old Jeffersonian maxim was that the country is governed the best that is governed the least.''

and further, in effect: If the people desire to make a radical change in the present constitutional theory of government they have the sovereign authority to do it; but only by amending their fundamental law. The present constitution was not framed on any such lines.

A more restricted construction has obtained in some of the eastern states. *Binsal vs. Yellott,* 100 Md. 481. But in the states of the middle west where the necessity for the sweeping restriction was appreciated, as here, the judicial construction has been uniformly with *Rippe vs. Becker,* with which *Jones vs. Froelich,* since it was decided, has been commonly associated. We may well add: *Nebedict vs. New Orleans,* 115 La. 645; *Leavenworth County vs. Miller,* 7 Kans. 479, 493; *State &c. vs. Kelly, et al.,* 71 Kans. 811; 6 Am. & Eng. Ann. cases, 298 and note.

The Minnesota court quoted with unqualified approval this view of the Kansas Court in respect to the term under discussion: "The state is absolutely prohibited from engaging in any kind of works of internal improvement. We will concede that this prohibition does not extend to the building of a state house, penitentiary, state university and such public improvements as are used, exclusively, by and for the state as a sovereign corporation; but it does extend to every other kind of public improvements."

(Meaning of the term Internal Improvements as indicated by the JOURNAL OF THE CONSTITUTIONAL CONVENTION.)

We might fill pages in the further discussion of this subject and use only the material found in the Journal of the Constitutional Conventions. No subject received more earnest attention or was more emphatically settled in the manner indicated in the fundamental law as we find it. It is thought best not to close this discussion without looking at the matter more particularly from the convention viewpoint.

The term "works of internal improvement" is open to construction as evidenced by the large amount of judicial labor which has been put upon it. That is conceded all the way along. Commonly, the debates in constitutional conventions have been referred to for the purpose of discovering the full meaning intended to be embodied therein. That was done, most significantly, in *State vs. Kelly,* where the court deemed it proper to incorporate into the opinion substantially the entire convention discussion, covering many pages. Courts, we reiterate, must in determining the meaning of an ambiguous provision of law look to the conditions with which the law makers sought to deal and the mischiefs they sought to prevent. As said in the Kansas case, in effect, the rule is specially adaptable to the task of determining the meaning of the term under consideration as the framers of the constitution understood it. We must look to the history of the subject as they had it before them and all the circumstances characterizing their action, particularly as appears upon the Journal of the convention. In short, we must strive by all means within our jurisdiction to put ourselves in the place the constitution makers occupied,—look at the situation they had in view through the same vista they observed it, and then read out of the term the meaning they sought to embody in it. It is in that way that this court in *Jones vs. Froelich,* and other courts have reached the conclusion before stated.

As indicated by the cases before quoted from, particularly our own, it was the principle at stake,—whether the new government should be confined to the ordinary civil affairs or be extended, at general expense, to those things of a public nature which were not really governmental in character, which was the subject of the convention labor. The calamities which had come upon the other states were, from first to last, held up as object lessons and every effort made to let down the bars at any point, defeated. True, particular improvements were now and then spoken of, but, in general, they were used to point argument as to the principle.

It is notable that one of the most strenuous efforts made to break in upon the majority idea was in the movement to modify the plan of the committee on education to, with the consent of Congress, devote to school purposes the 500,000 acres of land and five per cent on land sales granted to the state by the United States for the purpose of internal improvements, so that part or all thereof might, in any event, be used for the latter purpose. It was at this point that the opposition to the internal improvement idea was so great that, by the fundamental law, Congress was requested to change the direction of that grant.

Here, we may well say in passing, the expression was made by Mr. Estabrook, who was chairman of the Committee of Education, mentioned in *Jones vs. Froelich*—referring to the plan for a large common school fund, more than to the prohibition of the state's engagement in works of internal improvement. On the one side there was the effort to preserve the Federal grant for purposes of internal improvement. On the other there was the determination, with the consent of Congress, to cover the granted land, not impressed with any obligatory trust, into the school fund. Mr. Estabrook, referring to the strength of public sentiment in favor of the latter and against the former, said: "In the old constitution, the article in reference to schools was the precious jewel in the head of a toad." Journal of the Convention 238.

Later on we will have occasion to again refer to the strenuous contest between the advocates of state internal improvement activity and the common school leaders. Further on the subject now; one member of the convention said: "Every gentleman desires that the public lands shall be applied either to purposes of education or internal improvements." "I hope the subjects will be taken up together." Convention Journal 255. In the same connection a member remarked: "The proposition is to apply the fund to the purpose of internal improvement and it is very proper to inquire into the subject. If there is any article in the old constitution which was acceptable to the people, it was par excellence, that which appropriated this fund to purposes of education." Convention Journal 238.

Later it was suggested that the best system of internal improvements was one of general education and, further, that one of the causes which defeated the first proposed constitution was that which left open the opportunity to exploit the large general grant to the state for internal improvements. It was thought this time to prevent that peril by diverting such fund to common school purposes, if Congress would permit.

It is needless to say that the school fund advocates prevailed. In the contest is found the most emphatic condemnation of the idea of state burden for internal improvements. As before indicated, we shall have more to say on this subject under another head.

Outside the particular feature of the contest above mentioned, the debates, in the constitutional convention are very instructive. Mr. Gale "hoped no one would attempt to force into the constitution any provision which would allow our state to plunge into the gulf of internal improvements which had swallowed up the credit and prosperity of so many states. The state is not the proper party to carry on that system. The provision in the constitution prohibiting these works in the last constitution has given universal satisfaction. In fact one of the strongest arguments against the formation of a state government" was the danger of the state engaging in work of internal improvement. Journal 347.

Opposing a proposition to modify the absolute prohibition so that the state might engage in a particular work of internal improvement upon approval by a legislative enactment on referendum to the people, Mr. Kilbourn pointed out the uselessness of such a modification because any sort of such improvement at state expense, would be condemned by the people if given opportunity to vote direct upon it. Journal 350.

Mr. Larabee considered the whole matter "one of principle;" whether the state should, under any circumstances, engage in works of internal improvement; whether that was the best way to secure such improvements, and not a question as to how and under what restrictions the state should engage in them. It was clear to his mind that our own safety consisted in prohibiting the state, absolutely, from engaging in any works of the kind, except so far as the agencies of the state might be necessary in carrying out the objects of special grants or donations for such purposes.

So we conclude, as in *State vs. Froelich,* that it was the principle, in a broad sense, of whether there should be state competency to incur state burdens for internal improvements, other than such as might be required by the state for state purposes, not whether there should be such competency as to any particular species of such improvements of a public character, which was dealt with and decided in favor of the restriction. The really governmental features, except such as belongs in the field of police power, were specially treated under the titles: ''Declaration of Rights'', ''Boundaries'', ''Suffrage'', ''Legislative'', ''Executive'', ''Administrative'', ''Judiciary'', ''Eminent Domain'', ''Education'', ''Corporations'', ''Amendments'', and ''Finance''. Under the latter head provision,—except as to the very restrictive power as to purpose and amount, to borrow money or incur public debt—was made for an annual accumulation of money sufficient to defray the cost, denominated ''expenses of the state'', of all legitimate state activities.

VIIa.

The following is an abridgment of the forest reserve law to which the conclusion reached respecting the constitutional scope of ''works of internal improvement'' relates:

Section 1494—41 provides for a board of forestry consisting of the President of the University, Director of the State Geological survey, Dean of the State Agricultural Department, Attorney General and an appointee of the Governor, they to choose a president and secretary without compensation in excess of expenses.

Section 1494—42 provides for a state forester to be certified as to competency by the Secretary of the United States Department of Agriculture, salary to be $3,600 per year and expenses, to have power to employ a clerk at not to exceed $1,500 per year, be furnished office quarters and supplies, and to act as secretary of the Forestry Board. Under supervision of the Forestry Board he is clothed with broad jurisdiction over all forestry matters within the state. He is to collect statistics as to forest fire loss, aid in preventing such and other losses of forest property, promote forestry in this state, co-operate with the University of Wisconsin in drilling forest rangers and make biennial reports of the forest work with suggestions as to forest conservation, improvement and taxation.

Section 1494—43 withdraws all state lands north of Town 33 and possible reversion lands, from sale and provides that they shall constitute a forest reserve, such, however, as may be found by the Forester to be less suitable for forests than for other purposes to be sold by the Commissioners of Public Lands upon the Forester's recommendation and approval of the Board of Forestry, such Board to be competent to exchange lands. It empowers the Forester, under supervision of the Board, to manage the forest reserve, to employ necessary assistants, to institute on the reserve "conservative lumbering, make and maintain forest reserve nurseries, plantations and fire lines, execute other agricultural and protective measures, necessary to the highest permanent usefulness of the reserve in such lumbering under the supervision of the Board; to remove and sell, in his discretion, forest products from the reserve;" provides for his appointment as special fiscal agent of the state treasury department, and, upon his giving security, for money to be placed to his credit out of the forest reserve fund not to exceed five hundred dollars at a time, for his use for temporary laborers on the reserve.

Section 1494—43a provides for ascertainment of the available water powers upon the reserve and report of the same.

Section 1494—44 provides for acceptance of donations of lands for forest reserve purposes.

Section 1494—45 provides for co-operation by the Forester with the Federal authorities and those of other states and municipalities and other corporations and individuals.

Section 1494—46 provides for appointment by the Forester of an assistant with approval of the Board at a salary of $2,000 per year.

Section 1494—47 and 47a provide for fire wardens to serve under the Forester.

Sections 1494—48 to 60, inclusive, relate to minor administrative details.

Section 1494—61 provides that all proceeds from products of reserve lands, as far as the constitution permits, shall belong to the forest reserve fund and be used for purchase of lands to be added to the forest reserve, and forest reserve expenses.

Section 1494—62 provides for an annual levy of $35,000 per year for payment of salaries under the forest reserve law.

The following which do not appear in their logical order in the statutes should be considered in connection with the foregoing:

Section 257—1 provides, as to swamp lands, a special privilege to Towns north of Town 34, in that it affords to any such town the benefit for its drainage fund of the use of all such lands for cutting grass and picking berries. It also affords these special privileges: The proceeds, as regards cutting grass and berry picking privileges, on the lands in the forest reserve counties north of Town 33 go to the Forest Reserve Fund, but the like proceeds in all other counties north of such line go to the town where the lands are situated for the benefit of the town drainage fund.

Sections 1494—121–122–123 and 124 appropriate the proceeds of all state lands in Indian Reservations to the Forest Reserve fund.

Section 1072—1 provides $50,000 per year for five years for use, principal and interest, for purchase of lands for the forest reserve and for travelling expenses of a legislative forestry committee, the forester with the approval of the board to possess power to contract for the purchase of such lands and pay therefor as funds become available, the board to use the power of eminent domain for acquirement of land where necessary.

Section 1494—131 empowers the Commissioners of Public

Lands to acquire lands in the Forest reserve territory by purchase at tax sales and of counties of tax title lands and, upon request of the forestry board, of other lands all at the cost of appropriation for use of such commissioners.

Section 1494—132 gives the Commissioners of Public Lands one year option to take any lands in forest reserve territory acquired by any county upon tax title.

Section 1494—133 requires county clerks, upon lands being selected under the foregoing, to deed such lands to the state for the agreed price, not exceeding the cost to the county, payment to be made from the general fund appropriation.

Section 1494—134 preserves to former owners the same rights as to lands acquired as aforesaid as regards remedies against private persons, except no costs of litigation to be taxed against the state.

These features pervade the whole of the foregoing:

1st. Withdrawal of the lands from sale, except such as the Forester may decide to be more suitable for some other than forestry purposes.

2nd. Devotion of the lands to the growing of forest products, such to be removed for sale only so far as required to utilize dead and dying timber, and to be leased, in the discretion of the board, upon a cropping basis.

3d. Control of the lands by the Forest Reserve Board for forest reserve purposes, the Commissioners of Public Lands being subordinate at all points where left with any authority at all.

4th. General gainful business of silviculture and arboriculture.

5th. Business of gainful lumbering operations as deemed advisable to realize on forest crops.

6th. Ultimate gainful use, by lease or by improvement of water power opportunities in the reserve territory and on other state lands.

7th. Progressive increase of forest reserve territory by use of all revenues derived from forest reserve lands and appropriation from general state revenues, except as required for expenses of forest administration in excess of special appropriation therefor, and except as to small amounts to towns.

8th. Care of the state lands for the prevention and extinguishment of fires, and prevention and remedying of trespassing.

9th. Optional appropriation of the value, in excess of cost, of all tax title lands owned or acquired by counties in forest reserve territory.

10th. Special privileges conferred on municipalities in certain territory, not regarding any rule of equality, or the constitutional authority of the commissioners of public lands or claims of the school fund.

11th. In addition to the special appropriation of $250,000 from the ordinary revenues of the state, devotes other sums annually to establish, augment and promote the forestry business.

Thus it will be seen that the all pervading idea of the whole forestry scheme is substantial exclusion of the Commissioners of public lands from control over such lands, acquirement of a large forest area at the expense of the trust fund lands and general resources of the state, handling of such lands, including all the former swamp lands and other granted lands in a proprietary way, gainful use by business operations suitable to such an enterprise of forest reserve lands, with incidental gainful use of water power opportunities in such area, devotion of such area to the acquired use and annual extension of the business, so far as practicable, by use to that end of all the results of such business and an additional annual appropriation out of the general revenues of the state. No return to the general revenues of the state or to any of its specified funds is contemplated, or public benefit *in praesenti* unless it be in the nature of beneficial influence upon climatic conditions, conservation of the waters of rivers whose sources are in the reserve area, regulation of the flow of such waters, preservation and cultivation of the animal life of forests and streams and conservation of general facilities for hunting, fishing and otherwise enjoying life on wild unsettled lands.

That some features, at least, of the scheme as pictured spell "carrying on works of internal improvement" under the constitutional meaning of the term, there can be no manner of doubt; such as pledge of the revenues of the forestry business to augmentation of the forest area, especially, so far as relates to conservation of natural waters and regulation of the flow thereof for climatic, drainage or water power purposes or creating a game preserve territory and the carrying on of lumber operations, and permanent removal of a vast property acquired at public expense from the field of opportunity for any return to the tax payers of the present or even of the future, as the scheme now stands, if that is what the law means, which may not be the fact. But, in any event, the legislature has the field as regards disposing of the land so far as not restricted by the Constitution. One legislature cannot bind another. If the legislature of today buys land to keep, permanently, or decides to devote state trust lands, permanently, to forestry purposes, the next legislature, or any other, may decide otherwise, in its discretion. If one legislature decides to devote trust lands to forestry or any other purpose which is destructive of the constitutional purpose of the same being conserved with a view of producing money for the trust fund purpose, that decision would not stand the test of the constitution, as we shall see.

The mere reservation of the sale of state lands, until further advised, and augmentation of the amount thereof by use of the revenues therefrom for the purchase of adjacent lands, so far as not affected by the result of the next question to be treated, and the care of lands to prevent and extinguish fires, and prevent and remedy trespassing and control of the lands by a forestry board, and possibly the use of the general fund appropriations to purchase other lands adjacent, or the acquirement of such lands with a view of increasing the value of lands presently owned and of, within a reasonable time, reselling the newly acquired lands and return of the cost to the general fund and, perhaps activity to a still greater extent,—may not be within the constitutional inhibition. We incline to that view and that the forestry scheme is legitimate in its general features, as we shall more particularly see later, except in so far as it provides for lumbering operations and any diversion of the proceeds of the trust fund land to forestry purposes and unconstitutional disturbance of the commissioners of public lands as to control over the educational lands not having the cast of "school lands, proper" because of having been so dedicated by the terms of the grant,—in harmony with our conclusion upon the next point to be considered, particularly, the protection of the lands from fire, the selling of dead, down, dying and mature timber and deriving revenue from the annual, natural forest products; all with the primary purpose of conserving the property so as to obtain the greatest practicable amount, in the judgment of those in authority, of proceeds therefrom for the constitutional purpose and without fettering the lands so but that they may be offered for acquirement by private owners if the legislature shall see fit.

The point to be considered is of such vital importance and so affects this one that the latter cannot be determined, finally, by itself. So we will rest from our labor on this subject and go to the next, treating it under another head, only concluding for now that the present subject must be answered, in part, in favor of the plaintiff.

VIII.

Is it legitimate to set aside the trust lands or proceeds thereof, for a forest reserve, according to the legislative plan indicated in the foregoing, in view of Article X of the Constitution?

"Section 2. The proceeds of all lands that have been or hereafter may be granted by the United States to this state for educational purposes (except the lands heretofore granted for the purposes of a university,) and all moneys and the clear proceeds of all property that may accrue to the state by forfeiture or escheat, and all moneys which may be paid as an equivalent for exemption from military duty; and the clear proceeds of all fines collected in the several counties for any breach of the penal laws, and all moneys arising from any grant to the state where the purposes of such grant are not specified, and the five hundred thousand acres of land to which the state is entitled by the provisions of an act of Congress, entitled 'An act to appropriate the proceeds of the sales of the public lands and to grant preemption rights' approved the fourth day of September, one thousand eight hundred and forty-one; and also the five per centum of the net proceeds of the public lands to which the state shall become entitled on her admission into the Union (if Congress shall consent to such appropriation of the two grants last mentioned), shall be set apart as a separate fund to be called 'the school fund,' the interest of which and all other revenues derived from the school lands shall be exclusively applied to the following objects, to-wit:

1. To the support and maintenance of common schools in each school district, and the purchase of suitable libraries and apparatus therefor.
2. The residue shall be appropriated to the support and maintenance of academies and normal schools, and suitable libraries therefor.''

Section 5 provides for distribution of the school fund.

Section 6 provides for a State University and pledge therefor of the proceeds of all lands ''that have been or may hereafter be granted by the United States to the state for'' such purpose, the same to constitute a permanent fund, the interest only to be used for the support of such university.

Section 7 makes the Secretary of State, State Treasurer and Attorney General a board of commissioners of the school and university lands, with exclusive power to administer the fund arising from such lands.

Section 8 requires provision to be made for the sale of all school and university lands after appraisal thereof, fixes the rate of interest on deferred payments for land, empowers the commissioners to convey lands and discharge mortgages as necessary, to withhold lands from sale ''when they shall deem it expedient'' and to invest the proceeds of the lands ''in such manner as the legislature shall direct.''

The particular features of that section which are important is the pledge of ''all moneys arising from any grant to the State where the purposes of the grant are not specified'' to the school fund, the jurisdiction of the constitutional commissioners to invest the fund arising from the trust lands, the requirement of a provision for the sale of the lands and the jurisdiction of the commissioners in making sales with power to withdraw lands from sale in their discretion.

Thus it will be seen, there is a difference in the phraseology as regards the two classes of land,—those granted to the state for educational purposes, and those dedicated to that purpose when given to the state unfettered by any interfering trust. The "proceeds of all" the former and "all moneys arising from the latter" were "set aside as a separate fund to be called the school fund, the interest of which and all other revenues derived from the school lands" to be devoted, exclusively, to specified purposes. If room were left for legislative discretion as regards handling the second class none was left as to the first class, except subject to the power vested in the commissioners of public lands, and no room was left as to either class for any diversion of the proceeds of the first or the moneys arising from the second from the particularly specified purposes. Legislative jurisdiction was made very narrow as to the first class, at least, as plainly indicated by the debates in the constitutional convention, in order to guard against motives, prejudicial to conservation of the trust fund lands and money for the best interest of the schools of the state, partially or wholly, dominating the situation so as to, practically or wholly, defeat realization of the great anticipated benefits to the school system, so carefully provided for. That such idea evidences clear conception of popular control of things unless strongly fenced about by fundamental law, subsequent events, especially as disclosed in this case, bear witness. It is conceded, as we understand it, that, so far as the legislature interfered with control conferred upon the commissioners of lands which were granted by the United States to this state for educational purposes, of which there was only a small amount, when the forestry scheme was constructed, and set aside such lands and the proceeds thereof for a permanent forest reserve, it exceeded its power. It must be kept in mind that, by the forestry scheme, control of all the lands was practically taken away from the constitutional officers,—school lands under specific grant, university lands, Agricultural College lands and specifically granted Normal School lands, aggregating some 27,160 acres (See statement for details of this) as well as 240,000 or more acres derived from the swamp land grant. There can be no question but what the control and administration of the first four classes of lands is vested in the Commissioners of Public Lands with some power of regulation as to disposal, not including withdrawal of the lands from sale, permanently, or at all; but how about the lands which came to the state under the Swamp land grant?

We should say, in passing, that the amount of land involved as shown by the return, which was taken as the basis for what is contained on the subject in the statement at the head of this opinion, was made up for the assessment of 1913, and does not disclose the facts as they existed at the origin of the forestry scheme. The public records, statements from which have been made a part of the pleadings since the case was submitted, indicate that some $422,000 was derived from lands in the forest reserve territory from the date of the act of 1905 to the date of the assessment return. About $328,000 of that sum came from sales of land. Doubtless the total amount of the trust lands at the origin of the forestry scheme in 1903, and which was affected thereby and the later act, north of Town 33, is not less than 240,000 acres, derived by the state under the swamp land grant.

The question is raised as to whether those lands which have been carried on the state records since 1865, as will be hereafter shown, as half drainage and half school lands, under the name of "Normal School lands," and the half of all other lands which the state derived from the swamp land grants are not as far removed from legislative interference as University land, or the class of school lands which were granted to the state expressly for educational purposes.

At this point we have, perhaps, reached a very vital feature of this case. It has led to a study of the constitutional plan for a school fund and the administration thereof, as regards trust lands, for the past sixty-five years. The dignity which was given to the plan in the constitutional convention, and the execution of it for half a century after the constitution was adopted, will throw light on the fundamental meaning of the language of Section 2, Article X aforesaid—"All moneys derived from any grant to the state where the purposes of the grant are not specified."

As we have seen, substantially the same language as that quoted was used with reference to "lands * * * granted * * * to the state for educational purposes." It was the money derived from the lands, regardless of class, which was dealt with in section 2. All were set aside as a separate fund to be called the "school fund." Therefore, if the swamp grant lands, in part, became, in due course of time, "school lands" the fundamental protection of Art. X of the Constitution, automatically, was impressed thereon so as to prevent legislative interference therewith, at least, as regards diverting the money arising therefrom to any other than school purposes, the same as in respect to what may be called "school lands proper." As to such, the legislature cannot withhold the same from sale, since jurisdiction in that respect, as plainly seen, is given to the Commissioners of Public Lands. It cannot devote the same to parks or forests or any purpose, inconsistent with the constitutional mandate. *State &c. vs. Cunningham,* 88 Wis. 81.

Here is a case where the characterizing circumstances of the adoption of a term are especially helpful in reading out of it the fundamental purpose. Education, and that of a nature which reaches the boys and girls in every quarter of the state,—common school education and training for the profession of common school teacher, was one of the most cherished thoughts of the dominating figures in the constitutional convention. While the overshadowing need for that, and the universal verbal advocacy of it was acknowledged, a general apathy at the source of vitalizing the wish, the tax payers, was freely confessed, and to meet that it was proposed to create the largest possible school fund which could be gathered from sources other than public taxation. That, it was thought, distributable only upon condition of local outlay sufficient with it for common school maintenance, would afford sufficient stimulation in the matter.

One member of the committee on education said: "If dependence is placed entirely or chiefly upon direct taxation for the support of common schools * * * it will be a long time before the state will have an efficient and beneficial system of public education. I believe that we want a liberal school fund—and am prepared to show our necessities will require the largest fund that can be realized from all the resources of which we can avail ourselves for that object."

Other members of the committee spoke with like urgency of the necessity of bringing into the common school fund all that could be reached. Before the committee reported its plan, which, in time, was adopted, it was anticipated, and the contest commenced to save the grant to the state for internal improvements, or some part of it, from augmenting the school fund. It was at that point in the debates that Mr. Estabrook, chairman of the Committee on Education, in the course of his enthusiastic advocacy of the contemplated committee plan, to be adopted from the proposed constitution of 1846, earnestly requested the opponents thereof to restrain themselves from prematurely pressing their points, and referred to the fact that the probable proposition the committee would present, met with general satisfaction before and, as compared with the whole of which it formed a part, it was like "the precious jewel in the head of a toad,"—the one, if no other idea, which survived the wreck of the first structure, emerging from the gloom with increasing brightness, to again appeal to the convention for approval without a stain upon it. An eminent member of the convention, Mr. Kilbourn, not a member of the Committee, likewise expressed himself, saying: "If there was an article in the old constitution which was acceptable to the people it was, par excellence, that which appropriated this fund, (referring to the internal improvement grant,) to purposes of education. It was said by many that if the old constitution contained no other good provision it ought to be adopted for that alone. I am in favor of retaining in substance the system there presented. It ought not to admit of a difference of opinion that such a fund so appropriated would be a public benefit. A general system of education is the only system we can depend upon for the preservation of our liberties. I do not believe that the whole fund will be any too much for a general system of education which should provide not only for common schools, but for those of a higher order. At any rate, it will require a very large sum to educate not only the children now here but those to come hereafter.''

That was the sentiment which strongly swayed the convention. It grew in intensity after the committee brought in its report, as consideration of it progressed. Contrasting the idea of internal improvements with the opportunity for all the children of the state to acquire a common school education, it was pictured as the best system of internal improvements that the ingenuity of man could design or his resources execute. Every effort to weaken the committee plan signally failed. Here is the significant circumstance, which cannot well be referred to too often, that after laying hold of, for the school fund, as strongly as possible the large donation from the United States for works of internal improvement and all other known sources of augmenting such fund, the idea of the Ryan committee, incorporated into the article on internal improvements, phrased so as to sweep in all possibilities, present and future, was made a part of the educational plan to the end that nothing should escape. The language was changed, somewhat, for brevity, at the expense of emphasis. The thought of the convention can most clearly be seen by referring back to the language of the Ryan committee, which, it is clear, was intended to be adopted in effect: ''All lands which shall come to the state * * * by grant where the grant does not specifically dedicate the same to any other purpose, shall be held by the state as a part of the state school fund, under the same trusts, reservations and restrictions as are provided in this constitution in regard to school lands proper.'' That seems very plain. Higher education was only incidentally spoken of in the convention. The secondary idea of the educational system was library facilities, and normal schools to provide professional common school teachers, as indicated by subdivisions 1 and 2, Article X of the Constitution.

The words "All money arising from any grant" must be read in connection with the previous words relating to grants expressly impressed with an educational purpose. "All lands that may have been or hereafter may be granted" &c. There was no existing grant not so impressed, but, evidently, such were expected. There had been agitation to that effect, as history shows. Both expressions referred to form parts of one harmonious system to effectuate a single purpose, to lay hold of, as was said, time and again, in terms or effect, all possible sources that would aid in realizing, in fact, the large common school fund which existed in conception. That the particular language was a drag net instrumentality to cover any possibility *in praesenti,* and probability or possibility of the future, is supported by sound reason.

We have thus devoted considerable space in bringing into light the vista through which we should look to the point of formulation of the term, "All moneys arising from any grant to the state where the purposes of the grant are not specified." We repeat that it was a drag net proviso, thrown out to cover present and future and gathered in all coming within its scope.

No apology seems necessary, under the circumstances, for going into this subject with the greatest possible thoroughness. The stake, as to the children, present and future, is of very great magnitude. If the claims on the part of defendant are sound, notwithstanding the great wisdom of the framers of the constitution to efficiently provide for common school education the great object in view, so far as relates to the school fund, has been practically lost sight of or ignored. With a high sense of duty to administer, to the best of their ability, the obligations of a great public trust, and to aid in remedying, so far as practicable, the mistakes of the past, if any there be, the present Commissioners of the Public Lands, under advice of the Attorney General, have exercised the most distinguished industry in trying to bring into the record in this case all the evidence in their offices, or within their reach, which might aid the court in vindicating the real right as to the numerous questions presented—particularly evidence of the past handling of the public lands and the disposition of the proceeds thereof. We may justly say here that, while the Attorney General permitted the use of his official position to enable the state to move, adversary in form, to compel the administration of the forestry laws as they appear upon the statute books, and has, with fidelity, officially represented that side of the litigation, he has shown the most commendable appreciation that, as an aid of the court in the administration of justice mere personal success from a partisan standpoint is nothing as compared to vindication of the right, and, so, has endeavored to bring all to the attention of the court, regardless of which side it might favor. The result is that many matters with reference to handling of the public lands and funds, which did not originally appear in the complaint and answer, have been added thereto, voluntarily, enabling us to refer to the same without depending upon whether we might properly do so because of their being matters of public record, though not formally brought to our attention in this case.

It is found that the first step which culminated in what we have seen, was taken in 1897, Chapter 367 of that year. Thereby it was provided that money derived from the sale of public land should be covered into the general fund, except where otherwise disposed of by constitutional provision. That took effect April 27, 1897, and was repealed September 1st, 1898, when the statutes of 1898 went into effect. Such is the situation because the law, as it had existed from 1865, devoting half of the swamp and overflowed lands to school fund purposes, was carried into the new revision and all acts or parts of acts inconsistent therewith were repealed.

Notwithstanding such repeal, that appears to have been overlooked, and from the enactment in 1897 to the perfection of the forestry legislation in 1905, somewhere around $500,000 was carried into the general fund from proceeds of the trust lands, and, since then over $400,000 more, derived from such lands in the forest reserve territory, have been carried into the forestry fund. It is safe to say that a large, if not the greater, part of this was school money, as the constitution was understood for about half a century. If that be true, it, with the probable value of the land remaining, according to the purchase value of similar lands as shown by the records and report of the state forester and interest on the diverted fund, must aggregate well toward $2,000,000 which should be credited to the school fund. Looking into the future with all its possibilities, it might be twice or three times that sum. It is upon this picture,—held up to us in connection with the one that the granted land which was converted into money during the first twenty years of our history and was diverted from its proper course,—that it is insisted, with much reason, that, practically, even the hope of a large common school fund has vanished, except so far as it is within the competency of the court to afford relief. That is the attitude of those who represent the plaintiff and who really stand for the sovereignty of the people as the only ray of hope.

Such is the great interest which is now in the balance, depending upon the right or wrong of defendant's contentions. Thus the situation which confronts us, justifies and demands the most careful study, that justice may not fail for want of industry or understanding, and that the reasons for our conclusion be spread upon the record with the greatest possible demonstrable plainness.

It was early understood, as it came to be decided, as we shall hereafter see, that the swamp land grant conferred upon the states entitled to the benefit thereof the title to all lands within its scope, unincumbered by any "enforcible trust" as some courts put it, guided somewhat, it seems, by the practice in handling such lands, though, as hereafter noted, the expression indicating that the donor did not retain any right of interference whatever may be a little too strong. However, the lands were, from the first, regarded as substantially free to be disposed of by the states as undedicated lands; lands, using the words of our constitution, "where the purposes of such grant are not specified" except in quite an uncertain sense. So such lands were customarily disposed of by state authority without any particular regard to any definite purpose. The particular treatment in this state will be referred to later in a history of the subject and on the subject of practical construction.

This state, for itself, quite early dealt with the swamp land grants holding that they did not carry any obligatory trust except that the state would act in good faith in deciding upon a matter of fact. It was held that the grants were absolute in fact as well as in form; but with a condition that the "proceeds of said land, whether from sale or by direct appropriation, in kind, shall be applied, so far as necessary, to the purpose of reclaiming said LANDS by means of the levees and drains aforesaid;" giving a very broad meaning to those words from the federal acts. (Ch. 85, vol. 9 Stats. U. S. at L. p. 519).

Thus it will be seen that the state was practically given an exceedingly broad field of discretion in deciding the question of fact, which related solely to the necessity or advisability of draining the particular lands covered by the grant. Full power was given to devote the residue to such other public purpose as might be thought best. As to such residue "the purposes of such grant are not specified," using the words of constitutional appropriation of that species of land. As to such lands there was no trust, as between the State and the United States, which would follow into the hands of a private owner under conveyance from the state, though the idea that the lands were left entirely free from any interference by the United States, is wrong, and our constitutional appropriation, in recent years, has been quite overlooked. *Town of La Pointe vs. Town of Ashland*, 47 Wis. 251, in respect to freedom of the lands from any trust to the United States has evidently been misunderstood and misapplied, and our constitution overlooked leading many to assert, with confidence, that the state may handle such lands as a proprietor. It is almost marvelous how that false notion has taken hold of the minds of, even members of the legal profession, in that part of the state where swamp lands have been dealt in with much freedom, and furnished a ready object for exploitation. The confident assertion of such has gone far to pervert the public mind on the question. That it reached the legislature and gave cast to the legislation, when there was so much private interest in having the lands handled, as free from any special public trust as possible, is not very strange.

The title to all lands of the character described in the grant passed by force of it to the state, whether known *in praesenti* or not, surveyed or unsurveyed. All that was required was to identify the lands impressed with the act, to perfect the title of record as of the date of the donation. There was no condition of reversion and no obligatory trust, except to act in good faith, and none which attached to and traveled with the title. In case of an abuse of the trust, doubtless it was competent for the United States to interfere, but the discretion of the grantee was given so wide a leeway that we are unable to find where it has been challenged by the United States, the only party competent to do so. The status of the particular land has been so long and so firmly settled that citation of authority in addition to our own cases seems unnecessary, but we will refer to a few cases, among those cited by counsel for plaintiff. *Town of La Pointe vs. Town of Ashland,* 47 Wis. 251; *American Express Company vs. Adams Express Co.,* 110 U. S. 61; *Mills Co. vs. Railroad Co.,* 107 U. S. 557; *Simpson vs. Stoddard,* 173 Mo. 455.

The foregoing is a most illuminating background for the legislative dealing with the subject when the ideas of the convention were yet fresh in the public mind, and the actors in the constitutional drama were in being to give direction to affairs.

The early legislature must have known that the large swamp land grant was presented to the state to deal with in its discretion. Furthermore, that states, in general, had acted upon the theory which early obtained judicial sanction, viz: That acting in good faith the swamp lands were available for any public use so far as not deemed by the legislature necessary for the primary purpose mentioned in the grant and not fundamentally appropriated. Free from the conditional use there stood the rest enveloped in the toils of that language which must be given its broad meaning, in the light of the lofty fundamental conception "where the purposes of such grant are not specified."

HISTORY.

Some of the matters mentioned in this history have been incidentally referred to before. They may be in further branches of the case; but it is thought best to bring them all together at this point, arranged in their logical order. They will be seen to tell a very interesting and persuasive story as to the ideas of the people of this state when the sentiments which ruled the constitutional convention in formulating the fundamental law and guided the electors in approving of it, were still uppermost in thought. It may well be presumed that the same sentiments led to the results which followed, remembering that a large school fund was the ambition of the hour; that the constitutional methods of acquiring it were fresh in mind; that the original actors were the most influential factors in public life, doubtless bent on seeing their conception grow as speedily as possible into a reality, and that some of them were members of the legislature when the vitalizing acts commenced.

By Chapter 125, Laws of 1856, provision was made for disposition of the lands in question in harmony with what has been said. They were recognized as being logically within the administration of the Commissioners of Public Lands. The existing regulations for sale of school and university lands were applied. Direction to sell was given, a minimum price of $5 per acre being fixed. Note that private desire to acquire the land was not yet active, or if so, not influential. To increase the revenues as much as possible, it was declared that all lands acquired by the state in lieu of swamp lands should belong to that class for the purposes of the act. It was provided that after payment of the expenses of the sale "seventy-five per cent of the residue of all of the money from the selected lands" (in lieu of swamp lands) "shall form and be a constituted part of the school fund of this state and shall be subject to the same uses, designs, regulations and laws." Note the peculiar form of the expression "be a constituted part" &c. The remaining twenty-five per cent was directed to be paid to the county treasurers of the counties within which the lands were located, subject to be drawn by the towns therein where such lands were located, on application and representation as to such lands being susceptible to drainage and that the proportionate share was required for that purpose. It was further provided, that all money not so applied for within two years "shall be paid into the state treasury" and that the same shall form "a constituent part of the school fund and shall be managed" accordingly.

Except as stated the lands were placed in the school and university class and all acts inconsistent therewith were repealed. The latter clause was evidently added by force of custom and as evidence, on the face, that the enactment was intended to cover the subject entirely, for there were no acts, so far as we can discover to which the repealing clause could apply.

The enactment of 1856 was carried into the Revised Statutes of 1858 as §24, Chapter 29. Though the revision took effect January 1st, 1859, it did not affect the act next to be mentioned because of a saving clause as to all acts of the legislature of 1858.

At the session last mentioned, the legislature conceived the idea that ambition for a large common school fund might have been carried to such an extent as to lay the state open to a charge of not having dealt with the swamp land grant in good faith, in making so small a provision for the primary purpose of the grant. That resulted in passage of Chapter 67, Laws of 1858. In the opening lines are the words, "For the purpose of carrying out the intention of the Act of Congress" &c. To that end the moneys arising from sales of the lands to be devoted to the primary purpose of the grant was raised to fifty per cent, and particular provision, as theretofore was made to secure faithful expenditure thereof.

In 1859 influences became efficient to induce legislative departure from the original idea. By Chapter 164 Laws of that year, the drainage fund money, apportioned to counties, was directed to be expended in such counties for road building. This invaded the primary purpose of the grant without affecting the constitutional appropriation under consideration, as the disturbance only related to the fifty per cent set aside by the act of 1858 for drainage purposes.

In 1864 there was substantial forgetfulness of the primary purpose of the swamp land grant and of any constitutional claim as well.

By Chapter 431, Laws of that year land in Clark and Marathon counties was devoted to road building and incidentally to drainage.

By Chapter 432, ten sections of land in Marinette County were set aside to aid in the building of an interstate bridge.

By Chapter 436, lands in Crawford, Vernon and La Crosse counties were appropriated for building a particular road, nothing being said about drainage.

By Chapter 437, some lands in Juneau and Wood counties were appropriated for road construction, nothing being said about drainage.

By Chapter 439, the state attempted entirely to abdicate its trust as to lands in Calumet and Manitowoc counties by a legislative appropriation of the same to such counties to hold in fee simple, but in trust, partly for drainage purposes, partly to aid in bridge building and partly for building district school houses and maintenance of schools.

Thus a combination of eleven counties participated in the successful assault upon the original plan for use of the swamp lands. It is interesting to note that all the enactments took the same course and were approved on the same day.

At the next session of the legislature the acts of the previous session which we have detailed, and all other acts relating to the swamp lands, were repealed. The Legislature seems to have been conscious of a bad record having been made and much confusion created. To rectify that, by Chapter 537 Laws of 1865 the slate was made clean. All lands were recalled for redisposition, subject to existing contracts, "so far as the title to the granted lands may have been diverted under such acts."

For the purpose of preventing any further confusion of lands to be devoted to drainage purposes with those to be regarded as school fund lands, the plan of division of 1858 was substantially re-enacted. The new enactment practically related back to the time of the disturbance of the act of 1858, and it was provided that all the proceeds of lands and undisposed of lands should be divided into two equal shares "one to be denominated the Normal School fund" and "the other to be denominated the drainage fund." Note that the Normal School fund idea was first in thought, and that it was one of the constitutional purposes of the school fund. The most careful provision was made for partition of money, contracts and lands; those belonging to each class to be specifically designated and thereafter administered separately so far as necessary to prevent future confusion of the two resources and purposes. It was made the duty of the Commissioners of Public Lands to make the partition and duly file their decision, to take effect the first day of June, 1865, to publish such decision, and furnish every town clerk of a town and county clerk of a county, wherein any of the lands were situated, with a copy. The act was made as comprehensive as possible so as to cover, not only all lands then carried on the books as coming from the swamp land grant, but all that might thereafter be identified as belonging to the state as swamp land, or selected, under Act of Congress on the subject, in lieu of swamp lands.

Pursuant to the foregoing, in due course, the Commissioners of Public Lands, Lucius Fairchild, Secretary of State, Samuel D. Hastings, State Treasurer and Winfield Smith, Attorney General, made their decision, in great detail, and filed it in their office as such Commissioners.

The contents of the report and decision bear striking evidence of the thoroughness with which the commissioners did their work.

A basis of one dollar per acre was taken as a guide to go by. A careful compilation of all lands on that basis and all dues for lands sold showed the amount to be dealt with to be 2,218,854.13, acres and dollars. There were, tentatively, set aside for the fund denominated Normal School fund 504,596.35 acres of land which, with dues on outstanding contracts, loans and some forfeited lands made up 1,128,246.55 acres and dollars, and for the so called drainage fund 1,034,103.65 acres which, with dues on certificates and other claims, made up 1,109,427.06, acres and dollars. The two parts were brought to an equality by charging the Normal School fund, in form, and crediting the drainage fund with $18,819.40, to be paid out of the first sales of lands belonging to the former fund.

It will be noted that the Normal School fund, as regards present use, was regarded as first in importance. Some over $400,000, income paying assets were awarded to that fund, while only around $75,000 of such assets were awarded to the drainage fund, the two funds being evened up by awarding to the latter some twice as many acres of land as to the former.

The decision contained a designation of the lands by descriptions set apart for the respective funds. The report was recorded in the State Land Office and the land appropriately marked on the books of such office, so that in future sales, the proceeds would go to the proper fund.

As part of this history, it should be noted that, in the report of the State Superintendent of Schools, made by Hon. John G. McMynn, to the Legislature of 1865, particular attention was called to the provision of the Constitution under consideration. It was copied into such report. The swamp lands were mentioned as one of the four sources for the school fund and necessity for legislation for conservation of the funds was pointed out.

At the sessions of the Legislature of 1866, 1867 and 1868, some small invasions of the work aforesaid were made though none material, if at all, affecting the integrity of the school fund feature. However, the interfering acts were such that, at the next session, by Chapter 151 of that year, they were expressly repealed and the act of 1865, in its entirety, re-enacted and the partition thereunder was, so far as the records show, never disturbed or confused for some thirty years thereafter.

From 1869 to the new revision of 1878, there were several interfering enactments, but none affecting the integrity of the Normal School fund. In such revision the acts of 1865 and 1869 were written as Section 250 and 251, with this note by the learned Revisers and approved by the Legislature: "Based upon Chapter 437, 1865 as re-enacted in Chapter 151, 1869, and declares the result of the decision made in pursuance of the law of 1865 the records of which were made at the time and are preserved in the land office."

A particular feature of the Acts of 1865 and 1869 was made §251 in the new revision with an explanatory note to the effect that, in case of other lands or money in lieu of the swamp lands coming to the state under the swamp land grants "they ought to be divided on the same basis already established and upon which the former division was made."

Note the language "the same basis already established." Is that not of special significance in view of the fact that it is the expression of five of the most eminent lawyers of the state, two of whom were justices of this court when their work received legislative approval? Note that they spoke of the result of the partition proceedings as a decision. They doubtless used that term advisedly. They were men who would not be likely to use such a term loosely. They regarded the award as a final decision, evidently, up to its date as between the primary purposes of the grant and the constitutional dedication of all the lands not needed for such to school purposes. They probably thought it as final as any decision could be, not pronounced by a court of last resort. That explains the care exercised to add section 251 so that such decision would attach to any other lands which might come to the state of the same class. That they had in mind the two purposes to which the lands were required to be devoted as regards the proceeds thereof, there can be little if any doubt.

For further confirmation of the foregoing, there is the deliberate decision of the Legislature of 1889. By Chapter 340 of that year,—in an enactment prefaced by a preamble of five carefully phrased paragraphs, reciting the history of the swamp land grant and its administration in this state, particularly the decision of 1865, awarding one half of the proceeds of the lands to the primary purpose of the grant and the other half to the normal school fund, and the rights of certain counties where the lands were situated to have the use of the drainage half for its appropriate purpose—to vindicate the integrity of the partition aforesaid it was enacted that "the proceeds of the sales of lands * * * shall be paid one-half into the drainage fund of the counties entitled thereto * * * and the balance into the normal school fund" and the secretary of state was directed to issue warrants from time to time accordingly.

In the ~~seventeen~~ 27 sessions of the Legislature after the Act of 1865, bringing the history down to 1903, there was no legislative interference to speak of with the normal school lands except the brief period before mentioned between the act of 1897 and its repeal by the revision of 1898. The two sections, §250 and §251, stood without change until 1903. They disappeared from the statute books by the Forestry act of that year (Chapter 450) which was substantially confirmed and enlarged by the act of 1905 (Chapter 264), though, as we have seen, the officers of the state having to do with the matter lost sight of the facts some five years earlier.

From the date the Revision of 1898 took effect up to the time of the act of 1903, there was not the semblance of authority for not putting the moneys arising from the swamp lands which had been set aside for school purposes as aforesaid into the normal school fund. After such act the administrative officers had to take the law to be as it read, or force an issue in respect to the matter, as was finally done.

Why the integrity of the school fund was not efficiently looked after by those charged with the duty of specially guarding the school interests of the state, it is not our duty to inquire or to even speak in criticism, though we may well suggest the matter for future guidance.

PRACTICAL CONSTRUCTION.

Whether the constitution as to the proceeds of all lands granted to the state so far as free from any interference by the terms of the grant, should be held to include such swamp lands as were not needed for the primary purposes of the grant, is strongly evidenced in the affirmative by the rule of practical construction, as the foregoing very clearly shows. No rule is more helpful than that, where there is good room for its operation. None, in such circumstances, is more conclusive of legislative intent. The effect of it is to give to the language of the law, otherwise obscure, a cast in harmony with long established administration, as plainly observable as if incorporated therein in its letter. This court has spoken very decisively on that subject and nowhere more than in *Harrington vs. Smith,* 28 Wis. 43, 68. "Long and uninterrupted practice under a statute, especially by the officers whose duty it was to execute it, is a good evidence of its construction," and such practical construction will be adhered to even, though, if it were *res integra,* it might be difficult to maintain it.

The language of DIXON, C. J., speaking for the court in *Dean vs. Borchsenius &c.* 30 Wis. 236, 246, seems to fit this case. "The uninterrupted practice of a government prevailing through a long series of years, and the acquiescence of all its departments, legislative, executive and judicial, sometimes becomes imperative even on constitutional questions. If ever there were such a case this would seem to be one."

The foregoing is strongly reinforced here by that other rule of construction: Where the intent is plain and there is opportunity to choose between a restrictive and a liberal construction and the latter accords with such intent, it should be accepted as pointing the way to the right of the matter and should be extended so far as the rules of language will permit and is necessary to effectuate such intent.

No narrow construction will do here, in view of the history of the constitutional convention. To say that the swamp land grant is not within the constitutional meaning of "the proceeds of all lands where the purposes of the grant are not specified" because there is a specified purpose coupled with a limitation, in view of the long and earnest work in the convention to make the school fund as large as possible, laying hold of every resource, present and prospective or even possible, for that purpose, is to try to evade it, not to apply and administer it.

Force is added to the foregoing by this: The particular section of our constitution has been incorporated into several state constitutions without any, or material, change. Sec. ~~4~~ 3, Art. ~~1~~, 6 Constitution of Kansas; Section 2, Art. IX Constitution of Washington; Section 5, Art. IX Constitution of Missouri, 1865; Section 2, Art. VIII Constitution of Minnesota added November 1881. It should be noted that swamp lands are specially mentioned with a direction as in our act of 1865, "the principal to be preserved inviolate and undiminished; one half of the proceeds of said principal shall be appropriated to the common school fund of the state."

The Minnesota court in *Scofield vs. Scheaffer,* 104 Minn. 133, held that, though the lands came to the state substantially unfettered by any trust, under the state constitution they were placed on the same footing as lands, in terms, granted for school purposes,—or, as expressed in the Ryan committee article, as before indicated, placed "under the same trusts, reservations and restrictions as are provided * * * in regard to school lands proper."

The conclusions under this head of the case are these:

The term "all moneys arising from any grant to this state, where the purposes of the grant are not specified," used in Section 1 Article 10 of the Constitution, with its context, automatically carried any property donated to the state, whether under a grant existent when the constitution was made or a subsequent grant, to the extent that it was free from any obligatory trust for some other purpose, to the educational fund class of lands, to the extent at least of requiring the same to be conserved with a view of producing money therefor.

Upon the swamp land act taking effect, the title to all the lands, within its scope, situated within this state, as between the donor and donee, became impressed with an obligation on the part of the latter to decide and set apart, in good faith, the share of the granted lands needed for the primary purpose, leaving the balance free from incumbrance and subject to the constitutional burden under the section aforesaid, and that rule applies to all lands which came to the state under the national swamp land legislation.

The swamp land acquired from the United States, as stated, as regard moneys arising therefrom, can take, legitimately, but one of two directions; primarily, drainage purposes, secondarily, school purposes. Diversion of the same to any other than these two purposes is a violation of the fundamental law. Therefore so far as the decision of 1865 might be modified, it would result in changing land from the drainage to the school land class.

The fundamental burden impressed itself upon the granted property, simultaneously with the creation of the federal burden, both being afloat, but the former subservient to the latter, waiting upon a definite absolute determination of the necessary extent of the burden. No question could properly be raised in respect to that, as regards the dedication of the "moneys arising therefrom" to the school fund. None, otherwise, as to the disposition of the land, except between the donor and the donee. *State vs. Hastings,* 11 Wis. 448. Nothing could properly interfere with the extent of the secondary burden but the action of the state in deciding upon the necessities of the primary purposes of the grant.

Lands not decided to be needed for such primary purpose were automatically held fast by the secondary trust.

Decisions elsewhere in the absence of such a self executing appropriation of free granted lands as exists here, declaring, broadly, that the state, subject to challenge by the United States for bad faith, may dispose of the lands derived from the United

States under the Swamp land act as it seems fit within a wide range of judgment, and decisions, if there be any, where there is such fundamental element as we have, but it has not been appreciated, are beside the case.

The deliberately made partition of lands derived by the state under the swamp land act, which was made under the state law of 1865 and confirmed by the act of 1869, illustrated by acquiescence therein for more than thirty years by all who had to do therewith, is a binding exercise of the state's option to take such part of the lands in question for drainage as it deemed necessary. The school fund share thereby passed wholly within the constitutional jurisdiction over lands held in trust for educational purposes, possessed by the Commissioners of public lands under the ruling in *State &c. v. Cunningham,* 88 Wis. 132, or by the legislature, according as we must decide there is a difference between the two classes of lands.

The forestry act of 1903 and that of 1905 and all other acts and parts of acts making up the legislative scheme for a forest reserve, so far as they violate the trust impressed on the swamp lands for school purposes to the extent which the same cannot be restrained, so as to avoid such interferences; are not the law of this state and so furnish no warrant for the claim of the plaintiff.

The foregoing means that the forestry acts to be legitimate must be restrained to harmonize with secs. 250 and 251 statutes of 1898. Such sections are a part of the written law of this state, unaffected by any act, or part thereof, so far as interfering with the proceeds of the lands partitioned off to the school fund class under the law of 1865 or lands which should be, under the rule there, going as in such act provided.

This result does not cast the slightest discredit upon forestry enterprise. We may well concede for it, as a theory, all that its most enthusiastic advocates claim, and concede the advisability of reserving, for a time at least, the trust lands from sale and that the trust fund has been a great loser by the injudicious manner in which sales have been made; but neither one nor all such can furnish any justification for overturning the constitution.

In entering upon a new field of activity as a state, regardless of how beneficial advancement may appear to be, we should stop to earnestly and efficiently inquire whether there are constitutional restraints in our pathway. The people, as a whole, upon reflection, will always be found to desire to have those safeguards maintained in all their integrity. Often enthusiastic well meaning experimenters and intended promoters of the common good, chafe under such restraints, or blindly go on, unmindful of the sleeping danger which needs but the judicial touch to effectually bar the way.

Much confusion in public affairs would be prevented by more study of the fundamental law and a better appreciation of what it means and of importance of fidelity thereto. It is as necessary now, if not more so, to the general welfare, both in respect to the people of the present and those who will come after us, as it ever was. Those who decry it may secure, efficiently, for a time, the public ear, at least have efficient influence with the people's representatives; but the principle so assaulted, notwithstanding the "black menaces" which sometimes seemingly surround it, is as secure as "a star in the maw of the clouds." Some time the winds raised by object lessons and reflection, "will come along and sweep them all away;" vindicating the sentiment that no enduring-worth-while-fame can be won by unfaithfulness to the Constitution.

Nothing in the foregoing should be taken as purposed to cast discredit on the investigator, experimenter and promoter in the economic field. Progress would move slow without such. A monument could not be erected so high as to exaggerate the debt of mankind to them. To examine, to analyze, to think deliberately practically and conservatively, and to restrain reasonably and fundamentally, utilizes the good and rejects the useless and harmful. It is at this point that extremes meet and then settle to an equilibrium. Less antagonism and more charity between those of the mountain top, of the valley, and of the plain, would promote the ideal of the greatest good to the greatest number and make the world happier.

It is not overlooked that section 1494—61 of the Forestry act recognizes possibility of some of the proceeds of land set aside for forest purposes belonging to some constitutional trust. That is seen in the provision, in effect, that all such proceeds shall constitute a part of the forestry fund ''except when otherwise disposed of by constitutional provision.'' But, evidently, such language relates only to land granted by the United States to this state for particular purposes and so designated by the Constitution. But here the withdrawal from sale, as we have heretofore shown, contains no reservation. All were withdrawn regardless of trust character, and placed under control of the State Board of Forestry, not only as regards the ''moneys arising therefrom'' but the disposition of the land contrary, in any view of the matter, to Sec. 8, Art. 10 of the Constitution as regards such moneys constituting a part of the school fund together with the proceeds of school lands proper. We may say, in passing, that we used the term ''school lands proper'' to distinguish, briefly, between lands which were granted to the state for educational purposes and such as partook of the nature of school lands by the secondary trust in respect to the swamp lands. That term was so used in the proceedings of the constitutional convention of 1846. As to the so called ''school lands proper'' this court early decided that the constitution clothes the Commissioners of Public Lands with ''power to withhold from sale any portion of such lands when they shall deem it expedient.''

It might possibly be held that the general language ''The sale of all lands belonging to the state * * * shall constitute a forest reserve,'' etc., evidences legislative intention as to state lands strictly so called; that is, land held by the state with full proprietary capacity to deal with the same for public purposes as a private owner might. But the whole shows that no such thought was in the legislative mind, though it may well be there was doubt as to power to do what was attempted. The act has been administered substantially as we have heretofore seen, as if the words "state lands" covered all lands the title to which is vested in the state and in harmony with a prevailing forgetfulness that the trust lands cannot be dealt with as state property, that they are impressed with a special constitutional trust and the control of them, in the main, as to "school lands proper" at least was placed, absolutely, with the three constitutional officers, the Secretary of State, State Treasurer and the Attorney General as a Board of Commissioners, as a sort of corporate body.

VIIIa.

In the foregoing, at many points, the question will be seen to have been reserved, expressly or impliedly, of whether the constitutional jurisdiction of the Commissioners of Public Lands is common as to both classes,—educational lands proper, and those which partake of that nature as regards the "moneys arising therefrom," at least. The court is of the opinion that there is some reasonable basis for holding that, as to the disposition or use of the latter class for the purpose of so deriving "moneys" authority was retained by the people to be exercised in legislative discretion; keeping primarily in mind the constitutional intent to make the same as fruitful a source as practicable of moneys for the school fund.

The ground for a distinction, as before indicated, lies in difference of phraseology in Sec. 2 of Art. X of the Constitution heretofore mentioned, and the use of the term "school and university lands" in the section creating the board of commissioners and also in the section defining its power, thus referring, in the latter, to the particular lands which came to the state impressed with a specific trust for educational purposes. True, the administration of the second class for a great many years proceeded, in common with that of the first class; but, commencing with ch. 125, laws of 1856 and running through ch. 537, laws of 1865, ch. 151, laws of 1869, and other acts, the legislature, quite freely, directed the sale of lands of such second class and administration thereof somewhat inconsistent with the Commissioners of School and University land possessing that measure of jurisdiction over the same which they possessed over "school lands proper."

The court does not lose sight of the fact that administration of the swamp land class of school lands, under legislative direction, was left for some forty years with the Commissioners of School and University Lands; nevertheless, the history of the subject quite significantly shows that, in respect thereto such commissioners looked to the law-making power for authority rather than to the Constitution. It is true that, in most respects, the acts of the legislature incorporated into legislative language the idea of the fundamental law as regards "school lands proper;" but, here and there, it may well be said, there is some want of harmony and, it is a fact, that the legislature, in the beginning, and consistently thereafter, gave specific directions as to the second class lands, which were unnecessary if the Constitution covers the subject. That challenges attention to many points, practically connecting up from the beginning in 1856.

Therefore, under the rule that all reasonable doubts must be resolved in favor of the exercise of legislative authority, and that of practical construction as well, we incline to the view and so decide that the term "School and University Lands" in sections 7 and 8, Art. X of the Constitution relating to the creation and power of the Commissioners of Public Lands, does not include lands in the nature of school lands which were derived from the swamp land grants; that, as to such lands, such commissioners have only such power as the legislature may see fit to delegate to them. Whether the better policy is not to have a divided administration in respect to the lands of the two classes, or those and the drainage lands, is a matter for legislative discretion. Conditions may at one time favor the latter policy and at another the policy which now exists. It is entirely within the province of the legislature to decide that matter.

The foregoing does not militate at all against the integrity of the provision of section 2, Art. X of the Constitution that the "moneys arising from" the second class lands must be set apart with other moneys referred to in such section "as a separate fund to be called 'the school fund'" and that, in obedience to the spirit of the fundamental law, in legislative administration of such lands, the primary purpose should, and fundamentally must be, to produce money—using the legislative language in the act of 1856, "to be a constituted part of said school fund." That obviously renders nugatory any legislation purporting to authorize a diversion of the moneys arising from such lands to any other than the constitutional purpose, and likewise condemns any disposition or use of the land which does not have for a primary purpose the production of such money, though, doubtless, that leaves a wide field for legislative discretion in respect to withholding the lands from sale and improving the same by reforestation or afforestation which will be referred to again hereafter.

IX.

If the conclusions already arrived at were different we would have to face the further question next to be settled. Though the final outcome of the litigation, looking to the situation as it now appears, might render it unnecessary to even consider such question, since it is within the field covered by issues formed in response to the court's suggestion, and it appears now, as it did when such suggestion was made, to be of farreaching public importance, and counsel for the litigants have submitted it for decision with helpful discussions and citations of authority, it does not seem best to pass it without at least pointing out its dangers and general limitations, even if a definite principle be not announced which will include the particular matter. This is the question, though stated somewhat more broadly than in the basis for the formation of issues:

Is it competent for the legislature to burden the people with taxation to raise money to purchase lands for a large forest reserve, the anticipated benefits of which will, necessarily, be postponed to some indefinite time in the distant future, and to likewise burden the people with the expense of cultivating such lands for public benefit?

The question relates, particularly, to the appropriation of fifty thousand dollars per year for a period of five years under the act of 1911 (§ 1072—1 Stats.), the appropriation of thirty thousand dollars per year out of the general fund for the purpose of paying the salaries of the state forester and his assistants in carrying out the forest reserve plan, and the appropriation of ten thousand dollars out of the general fund under §172—37 Stats., to purchase tax title lands for the forest reserve under § 1494—131, 133. Probably there are other statutes but these are the main ones and, though the system is yet in its infancy, they cover ninety thousand dollars per year.

It is contended that such appropriations and similar ones are not legitimate expenses of state government and so are not within the constitutional power to tax, and that the limitation upon the power to burden the people of the state by taxation for state expenses is the limit of the power to appropriate money out of the state treasury, since the only legitimate source for replenishing the public fund is by some form of taxation upon the rule of uniformity and equality, subject to the power of classification within the rules on that subject.

It is strenuously urged that there is a tendency to drift away from the old position, keenly appreciated when the people met to originate a form of government and that we should desist if not retreat. True, the country was then new and the people were poor. There were vast fertile prairies interspersed with wooded hills and valleys, with its empire in the background, extending over more than half the state, covered with forests, the growth of centuries, with its innumerable springs and lakes from which came a multitude of rivulets, augmenting to great rivers in their courses to meet the main artery of the west. Internal improvements, one well recognized great necessity for future growth, in their wisdom, looking to the experience of the past, in the most comprehensive and exclusive sense, they left to local units and to private enterprise under sovereign regulation and encouragement. Civil government in the simplest American form was all they thought to establish.

So they entrenched, as the substructure of their creation, inherent human right, with an accompanying declaration of essentials of administration and an admonishment to recur thereto frequently for guidance, lest that hoped for blessings of their efforts to endure permanently might fail of realization. On that they builded as the first course, elective machinery and a legislature to make written law within a closely fenced about field; but including power to form municipal corporations for exclusive local affairs and other corporations of a semi-public and also private nature, necessary or convenient to the development of the state and the employment of its people; then an executive department with administrative assistants to carry out the will of the people under the restraints of self imposed disabilities; then a judicial department to test situations as they should arise by legal standards to determine what is law in fact and what is mere law in form, and to apply the former; that was over-crowned with a provision for a broad system of general education with every possible facility for its maintenance encouraged by the maximum of resources with the minimum of private burden. Details were added of the ordinary kind, such as power of eminent domain, power to make additions to and repairs of the structure as needed, and adoption of existing unwritten law, subject to legislative change within fundamental restraints. They then vitalized the entirety by a plan for creating and circulating the necessary life blood for the particular state purposes in view, all on a basis of uniformity and equality and with well defined restrictions as to anticipating future resources, except in case of extraordinary occasions, to a small amount. Estimated expense, year by year, to carry on the government according to the constitutional plan was the ruling thought. It was provided:

> *"The legislature shall provide an annual tax sufficient to defray the estimated expenses of the state for each year; and whenever the expenses of any year shall exceed the income the legislature shall provide for levying a tax for the ensuing year*

sufficient, with other sources of income, to pay the deficiency as well as the estimated expenses of such ensuing year.''

Thus the constitution plainly contemplates legislative action to determine the sufficiency of income each year to cover the regular expenses until the next opportunity for such action, and for a legislative levy of a tax therefor and to make up any deficiency for the preceding year. Nothing in that field was left to administrative officers, but merely to administer. That is plain.

The supreme court of New York in *People &c., v. Board of Supervisors of Kings County,* 52 N. Y. 556, treated a similar subject, at length, and with much emphasis. As there indicated, the scheme of the constitution is to keep the subject of state appropriations for expenses and state indebtedness, as close to the people and within the disabilities created by the people as possible. The dangers thus sought to be avoided and the necessity of adhering strictly to the constitutional plan in order to make it an efficient safeguard against such dangers, were pointed out. The idea of blanket appropriations to cover indefinite necessities, leaving it for administrative officers to determine the amount of the tax levy, was condemned as wholly foreign to the fundamental idea.

So much for the general features of our system. As said in another part of this opinion, we must look at it from the viewpoint of the framers of the constitution. It means what they intended to have it mean not what, as an original proposition, we would like to have it mean. That may be different because of the environment of its creators than the same system might mean under a wholly different environment. ''A thing which is within the intention of the makers'' of a law ''is as much within'' the law ''as if it were within the letter.'' *United States vs. Freeman,* 3 How. 556, 565; *State &c., vs. Phelps,* 144 Wis. 1.

Principles are expansible, but not subject to be added to or taken from by judicial administration or declaration to cope with particular exigencies. The work of so coping in the field of fundamental law is reserved to the people themselves, as said in *Rippe vs. Becker,* 56 Minn. 100.

If the constitution contemplated public outlay other than in the governmental field covered by the various blocks so carefully carved out and fitted together in the fundamental structure, why the command for an *annual tax* sufficient to defray the *expenses of each year,* supplemented by an annual levy, if necessary to make up for the excess of expenses over income *for the preceding year?* Why was there no room left in the constitution for imposition of any tax for anything other than as indicated, expressly or inferentially, coupled with the most drastic provisions to prevent the creation of State debts for any but emergency matters of an extraordinary nature?

Placing ourselves where the framers of the constitution were placed and the people who ratified it, was it intended to prohibit such extraordinary matters as the expenditure of a very large amount of money to create and cultivate a vast forest reserve, costing millions of dollars, for use of the people of the far distant future? That, in view of modern conceptions, ambitions and paternalism, is a great subject. But it must be looked at, not from the high up point supposed to have been now reached, but from the level of the plane where the people stood when they created this government. I am not entirely satisfied to say, and certainly the court is not, that the power reasonably exercised and free from the internal improvement feature, if that be possible, does not exist at all. It is sufficient for now to point out the gravity of the subject. I am permitted to do that. It may lead to the precise question never having to be decidedly answered with detail limitations, without a change in the fundamental law. An aroused sense of legislative responsibility to vindicate it, doubtless, will result in reasonable doubts being resolved in that field in its favor.

PUBLIC PURPOSE.

It is a maxim of the law that the power to appropriate is co-extensive with the power to tax and so has fundamental and inherent limitations.

The first of such limitations is implied from the very nature of organized society. That exists for public purposes of a governmental character. The scope of such purposes, it must be conceded, except as expressly or by necessary implication fundamentally limited, is quite broad.

It follows that we need not, necessarily, depend on any fundamental limitations of the power to tax. There would be such if we had no constitution. Then, a tax could not properly be levied to take property from one person and give it to another.

Public purpose and the character of the tax otherwise, would determine its legitimacy. A state wide tax could only be levied for state wide purposes and so on down to the smallest taxing district. In either case, the purpose would need to be public, in the sense of a matter of common or general interest to those upon whom the burden is laid. This court discussed that at much length in *State &c. vs. Davidson,* 114 Wis. 563. We adopt, now, the logic of that case without extending this opinion for much rediscussion or quoting from opinions.

Other courts and text writers in general lay down the rule as above indicated. 2 Dillon Municipal Corp. (4th Ed.) 736, 737; Cooley Const. Limit. (6th Ed.) 608; *The People vs. Salem,* 20 Mich. 452; *Loan Association vs. Topeka,* 87 U. S. 655; *Pray vs. Northern Liberties,* 13 Pa. St. 104. In these citations, and many more which might be referred to, the principle will be found declared which has been incorporated into most elementary works. Where there is no public purpose, in the sense of carrying on some part of the machinery of government, there is no power to tax. As put by the Federal Supreme Court in *Loan Association vs. Topeka, supra,* an object which is not within the purposes for which governments are established, falls outside the limitation upon the right to take the property of the citizen, by way of taxation, for public use.

Another limitation on the power of taxation, from the very organic purpose of government, is this: At the point where reciprocal benefits end, the power of taxation also ends. The basic idea of exercise of the taxing power and justification for it, is that, it involves an exchange of equivalents. The taxing district obtains the contribution to the public treasury and the contributor, in return, receives a legal consideration of a pecuniary or protective nature to his person or his property or both. It is often difficult to appreciate just where the consideration comes in, but without it, in fact, the taking of one's property, though under the form of taxation, and, so, in form, by due process of law, would be confiscation,—an appropriation of private property for a non-public use, even though, in the particular case, the public might be interested in the enterprise promoted and be largely, incidentally, benefited. *Warden vs. Fond du Lac,* 14 Wis. 672; *Dalrymple vs. City of Milwaukee,* 53 Wis. 178, 179; *C. & N. W. R. Co. vs. State,* 128 Wis. 553, 653; Cooley on Taxation, (3rd Ed.) 22, 23, 24.

We need not stop to bring the stated principles home to the particular situation. Their application is obvious, but not so the conclusion. But how to square them with the imposition of large public burdens upon the people of the present without any hope of return to them, in addition to the benefits they enjoy as their equivalent for ordinary taxation,—burdens imposed with the avowed purpose of accumulating benefits for generations yet unborn, is somewhat puzzling.

The mind naturally reaches out to grasp some sort of present equivalent moving to the tax payer for the property taken from him, and, seemingly, closes upon a shadow. There must be some present benefit. It is not sufficient that the forced contribution will be a boon to some future generation. The state has no right to take the property of individuals presently and afford them no possible return, merely because the storehouse, being filled, will be opened some time, depending upon Providence and the majority as to when, for the enrichment or comfort of the people then in being in which the tax payer has no special interest which reasonably demands any such sacrifice.

There may lurk in the field of present protection to person or property or both, or, in what seems quite idealistic, a high moral duty to mankind, in general, without regard to place or time, the essential element of consideration, yet it must be remembered that even the demands of charity, springing from dire distress in some foreign jurisdiction, or any outside of the particular taxing unit, are not a legitimate basis for taxation of property in the particular jurisdiction, because of the absence of reciprocal obligations and benefits, in a governmental sense. *State &c. v. Davidson,* 114 Wis. 575. "There can be no legitimate taxation unless for the uses of the government," levying it. Dillon on Mun. Corp. (4th Ed.) 736.

If it were true that there are no inherent rights, only privileges possessed by individual members of society, one might see the equivalent for which the sovereign could exact whatever toll might be thought best for the enjoyment of such privileges. But from the standpoint of our American system of government which is based on individual possession of rights high above any power to take away or destroy,—which rights include as one of the most important,—really the one upon which all others are dependable,—the right to possess, to dispose of, or to enjoy whatever one acquires legitimately, according to his own pleasure, subject to such lawful demands as may be made upon him as his share of the expenses of government as the equivalent for present protection of his person and his property,—there is a difficulty, though perhaps not an insurmountable one.

THE PRACTICE ELSEWHERE.

We have been referred to statutes and practice in other states as having some bearing on the question of the legitimacy of using public revenue for forestry purposes, and will give some attention to that branch of the case.

We must say, at the start, that very little light can be shed on the question at issue by mere reference to foreign practices. At most, it can only throw light on whether there is such reasonable necessity for the particular activity to justify it, no fundamental limitation being in the way, under a head in this opinion yet to be treated. But, if others have made mistakes of a basic nature it furnishes no excuse for us to follow in their footsteps. Judicial discussions of the matter under conditions similar to ours would doubtless be helpful; but there are none cited to our attention, or which we have been able to discover. The subject involves important principles of government, some written and some unwritten. That we have seen, and will perhaps more clearly see, by the subject yet to be treated.

The great difficulty seems to be that opinions of those who have fostered the forestry movement have not always been guided by the truth that, while, in a sense "the right to tax," except as fundamentally restrained, "is the right to destroy," that contemplates the right to tax for vitalizing the functions of government. Within that field, in a limited sense, the saying of Chief Justice JOHN MARSHALL is correct; but the right to destroy for governmental purposes does not mean the right to confiscate. What would be destruction for governmental purposes under ancient systems would be mere confiscation under ours. The right to tax under the former is absolute while under ours it is not, even in the absence of a written constitution.

There is much evidence that the principles suggested have not been clearly appreciated where this subject of forestry has been dealt with. That failure has resulted, I think, from too much inclination to look beyond the boundaries of our country for models. That has been in evidence from long before the time of any of us here. There has, seemingly, been want of appreciation of the limitations of the rule early established that the common law prevails here except so far as modified by statute or unadaptable to our system and conditions. That element of unadaptability under our conception of inherent rights in place of privileges by grace was hardly understood when the idea took root which obtained quite generally for a century after our American system was established, that there is no natural right to inherit and none to participate in making a choice of agencies to vitalize civil government; both of which this court has seen fit to reject as heresies, viewed from the standpoint of our conception of such rights. *Black vs. The State* 113 Wis. 205, 233, *Nunnemacher vs. State,* 129 Wis. 190; *State &c. vs. Phelps,* 144 Wis. 1, 13.

It must be remembered that the foreign idea of government, as regards basic principles, is far different from ours. Theirs dignifies the sovereign as a personal personification of all power. In that personality is everything; the individual, nothing, except by grace, and so the logic of subordination of the individual to the supreme personality,—the ''I'', regarding the individual possessions as held by a privilege for any use the ''I'', through his ministers and agencies, may determine to be for the sovereign good.

In the formation of the first model of a constitution on our shores, all the logic of foreign systems was cast aside and a system took its place moulded by original creative power out of well known but unvitalized principles. The very opposite of the ancient idea was aptly thus expressed by the historian:

> ''As a sea is made up of drops, American society is composed of separate, free and constantly moving atoms, ever in reciprocal action, advancing, receding, crossing, struggling against each other and with each other; so that the institutions and laws of the country rise out of the masses of individual thoughts, which like the waters of the ocean, are rolling evermore.''

The rule of individuality from the standpoint of the common level was in contrast with that of all dependable upon one only of significance. So the central idea was that the individual should not be disturbed in his person or his property and should not be the subject of public care except within very narrow lines essential to civil government.

Again, no very helpful light can be thrown on the subject under discussion by referring to holdings in this country where there is no restriction by written constitution or under constitutions similar in letter to ours, but construed from a different standpoint and embodying the thought of the hour as to present and future. ''It is our constitution, not that of any other state we have to deal with. That is the great charter of our rights to which the humblest may at all times appeal and to which the highest must at all times submit. Our conclusion must be guided * * * by the plain, simple, but authoritative and mandatory provisions of our own constitution. We made it ourselves * * * We must construe it and support it * * * according to its plain letter and meaning. The people of other states made for themselves respectively constitutions which are construed by their own appropriate functionaries. Let them construe theirs; let us construe and stand by ours.'' Those words, by Smith, J., in *Bashford v. Barstow,* 4 Wis. 784, are apt in any case where the spirit of our fundamental law is looked for in decisions elsewhere under other constitutions.

Of the numerous laws called to our attention to illustrate, it is thought that no one fully fits this case, so far as legislative judgment is concerned independently of constitutional restrictions. The nearest approaches thereto are in Michigan and Minnesota, but there is no attempt in either state to create a large forest reserve, the income from it to be invested and reinvested for the continued enlargement and improvement of a vast forest area, ignoring the claim of trust funds, and the interests of the people in the immediate future in a return for their investment. Outside of the two instances, there is no semblance, in the middle west, at least, to a scheme such as we have here.

The restrained nature is strikingly illustrated by the statute of New Hampshire which we are cited to, under which the purchase of land is restricted to such as can be procured with money privately contributed. Chap. 44, Laws of 1893.

The law in Maine, another to which we are referred, is based on a specific provision of the Maine constitution, held to expressly authorize the appropriation, 103 Maine, 306. Moreover, it did not provide for any appropriation to buy land. There is no interference in Minnesota with land acquired from the United States or by other donations other than forest purposes. No lands are dealt with for such purposes except such as the state owns in its proprietary capacity or were donated for the particular use. The land purchase feature is quite restrictive and does not appear to be a burden on the general fund, except perhaps a small amount for park purposes. The scheme, in the main, is conservative instead of constructive. In case of improvement of swamp lands the area is restricted to a few tracts at a time with duty, after a moderate period for the improvement, to sell the property and cover the proceeds into the fund to which the land belongs. The scheme does not appear to have had judicial approval; even in its moderate form; moreover the constitutional financial restrictions are not, as here, though it was formerly otherwise.

The situation in Pennsylvania is very much as in Minnesota with the added feature of there being no such prohibition as here against the state engaging in "works of internal improvement."

In New York there is a plain constitutional recognition of state forestry as a legitimate subject of state activity and expense.

In Michigan the situation is about as in New York with this added significant circumstance that there is a prohibition against state work of internal improvement which in its original form was supposed to include reforestation activity. To render that legitimate the provision on that subject now excepts "reforestation and protection of lands owned by the state and expenditure of grants to the state of lands or other property." The forestry legislation is in harmony therewith. There is no appropriation of lands to forestry purposes which were set aside by the fundamental law for other uses. We might continue this review of public treatment of the matter elsewhere at great length. Suffice it to say, we are unable to find that any court has yet held that the legislature has power to do the thing under consideration,—burden the people with taxation to purchase and improve a vast domain for a permanent forest reserve, which does not contemplate any return on the investment to the state as a proprietor at any time, or to the people other than in the distant future. To acquire a vast domain by public taxation, to be held for permanent investment and reinvestment, and with the trust lands of the state, which were pledged by the constitution and by contract with the United States to other purposes,—is without precedent and without judicial sanction. According to the official reports, the domain contemplated here is a million acres, the reforestation of which, at the rate suggested, would cost around four million dollars and the entire investment five or six million dollars, more or less.

Another class of citations to which we are referred do not seem to fit the case. The nature thereof is well illustrated by the citation of the text, 26 Am. & Eng. Ency. of Law, p. 219, to the effect that, subject to constitutional restrictions and those inhering in a grant of lands, the legislature may exercise such power over them as it sees fit. No one can doubt that. The interferences here are just of that kind.

Numerous cases cited, mostly federal, to the effect that the government, as proprietor, may exercise its judgment as to what to do with its lands, has nothing to do with the point to be decided. True, the government of any state which has a proprietary interest in lands may, for a public purpose, expend money on them or sell them or not, at its pleasure; and so a city may appropriate money to buy land for a public park. All these matters are called to our attention to support the contention that the state may constitutionally do what is called in question here. It is not perceived that any of the premises we have mentioned or all of them together are conclusive or very persuasive that the state appropriations mentioned are legitimate, because they do not declare or illustrate a principle which clearly fits into our constitutional system, with its group of governmental functions and restrictive method of defraying the cost of executing the same. Such a broad far-reaching scheme as reforestation and afforestation at public expense, should be plainly grounded on some one or more of such functions.

Mere declarations, found here and there, which do not discriminate between what may be done and what the authors of such declarations think ought to be done, affirming as to the latter, as if anything which from the viewpoint of the authors is a good thing in a public sense, may be done at public expense, count for little. If there be a legitimate basis for a forestry scheme within the scope of our constitution, it is our duty to use our best endeavors to discover it and to entrench it so as to locate it within the fundamental field of taxation to the end that there may not be any future doubt in respect thereto. That being done, the legislature will, doubtless, exercise due care to conform thereto.

Meaning of "Expenses of the State."

We must keep in mind that the state tax burdens must rest on a public state wide constitutional purpose. *State &c. vs. Davidson,* 114 Wis. 563; *State vs. Froelich,* 115 Wis. 32; *State vs. Froelich,* 118 Wis. 129, and that it must fall within the constitutional scope of the term "expenses of the state" as used in Section 5, Art. VIII.

The power to raise money by state taxation was evidently intended by the framers of the constitution to be very closely fenced about. We must apply to their language the usual rule in such cases. Any other would weaken the fundamental law to the point of breaking. The power to tax is not retained by the people to be exercised by the legislature for all purposes not mentioned. Not by any means. Where the constitution deals with the matter, it deals exclusively. That is the rule. The language, in form, conferring the power to tax for a class of things "expenses of the state for each year," though in form in words of grant, is in fact a limitation, *expressio unius exclusio alterius.* That rule of construction is peculiarly adaptable to the clear reading of a state constitution, the provisions of which, properly framed, are mere declarations of principles of a general nature and usually in the mandatory or declaratory form.

If it were not for the light of the well known rule, many of such provisions, as has been said in the books, would be as meaningless as waste paper. It must be presumed that our constitution was formulated with reference to that rule which had long been established and which the many able men who were members of the convention well understood. One of the dominant purposes of the people in adopting their charter was to limit the power of the legislature to impose burdens in the form of taxation upon the inhabitants. Excesses in that regard had brought many of the older states to the brink of financial ruin. It was the great menace in that regard, which was the chief deterrent from starting out as a separate governmental organization. The mischiefs created by unbridled taxation power were comparatively nil in the territory. It was fear of an unfavorable change which led to the defeat of the first constitution more than all others.

Hence the great care in framing the chapter on finance. It was intended thereby to tie the hands of the legislature as firmly as Prometheus was bound to the rock. The chain was admirably conceived, link by link, the parts united together and the whole anchored in place. (a) Uniform rule of taxation; (b) Non-payment of money from the public funds except pursuant to a specific appropriation by the legislature for the particular purpose; (c) Disability to loan state credit or create any indebtedness or borrow any money except to a small amount, and that for emergency purposes; (d) No law to be passed by either house which imposes, extends or renews a tax or creates a debt or charge or makes any appropriation of public or trust moneys, or in anywise disposes of a state demand, except by yea and nay recorded vote with three-quarters of all the members present in each house at the time of such house acting in the matter; (e) No evidence of debt to be issued except for the small amount of emergency borrowing; (f) No state connection with internal improvements. Could a more closely fenced in field be thought of, leaving nothing therein but ordinary and necessary matters of civil government. Then, to give life to the structure, in effect, there is the provision for taxation year by year in advance sufficient to defray *estimated expenses of the state and any deficiency for the preceding year.* If this ideal plan were always carried out in performance, there would be less complaint of the burdens of taxation, but experience shows that in this field as in others

''The best laid schemes o' mice an' men
Gang aft a-gley
An' lea'e us naught but grief an' pain
For promis'd joy.''

The foregoing brings the subject of state appropriations for the particular purpose down to such a narrow, yet such a vital point that it may well be treated under a head by itself.

X.

Does the term "state expenses" include such as the appropriations to create a permanent forest reserve, the proceeds thereof to be invested and reinvested in perpetuity. The entire scheme of the act in question is thus embodied, though perhaps the perpetuity feature might be omitted without difference in result.

We cannot point to anything in the constitution which makes the particular matter expressly "state expense." We cannot point to anything there which in spirit makes it such, unless it is the inherent police power.

The police power is the broadest in scope of any field of governmental authority. It is inherent in the very nature of organic society. We do not look into the fundamental law to find it or to define it, but only for limitation upon it. It is as limitless as man's aspirations and conception of human welfare and its exercise is likewise limitless, where not fundamentally restrained. It has many such restraints, both express and implied. Internal improvement activity falls within the general field, but lies dormant in the shade of the constitutional prohibition. *State ex rel. Jones vs. Froelich,* 115 Wis. 32; *Rippe vs. Becker,* 56 Minn. 100. The actual and supposed beneficial influence upon individual and community life which might be derived from vitalizing the conceptions of sociological thinkers and would be experimentalists, is no excuse for an assault upon, or overturning at any point, the fundamental law.

If what was last said were better appreciated, much less mischief would be attempted and much less succeed, at least temporarily. Exercise of the police power is impliedly limited by the very spirit and purpose of the constitution to conservation of "life, liberty and the pursuit of happiness" and of all other inherent rights, "to secure which governments are instituted among men, deriving their just powers from the consent of the governed.'' Therefore, excessive exercise which impairs instead of promotes those rights, is deemed unreasonable, abusive of legislative discretion; and, so, unconstitutional. *State &c. vs. Kreutzberg,* 114 Wis. 530; *State &c. vs. Chittenden,* 127 Wis. 518, 521; *State vs. Redmon,* 134 Wis. 89; *Bonnett vs. Vallier,* 136 Wis. 193. Perhaps no heresy which obtained lodgment to some extent in the jurisdiction of this country was more pernicious than that which once was proclaimed by some text writers and courts, that the police power is free from constitutional restraints. Such a doctrine if adopted would render the constitution largely like the poet's characterization of life, a thing ''full of sound and fury, signifying nothing.'' On the other hand, no heresy which was once advocated and received distinguished approval, has been more emphatically repudiated than the one that the police power is a free authority, and by no court has it been rejected with greater emphasis than by our own. The phrasing of the matter in *State v. Chittenden, supra,* has come to be regarded as somewhat standard here and elsewhere by text writers:

> ''Legislation referring to police authority for legitimacy, like any other exercise of the law-making power, must bear the test of constitutional limitations, which will be found upon all sides. On the one side it may meet the barrier of an express prohibition; on another the implied prohibition of any law not in harmony with the all-pervading purposes of the constitution; on another the implied prohibition involved in the declaration that 'the blessings of a free government can only be maintained by a firm adherence to justice, moderation, temperance, frugality and virtue, and by frequent recurrence to fundamental principles' (sec. 22 art. I, Const.), and at last the limitation of reasonableness springing from the whole constitutional scheme.''

So it by no means answers the proposition now under discussion, favorable to plaintiff to concede that the particular appropriations are within the field of police power. The most serious question would then arise of whether they are within the constitutional exercise of such power. The great scope of it is such that no one would appreciatingly venture to say what it does not include, in the general sense, of the countless things which have to do with human welfare. The words of Judge COOLEY in the course of his very learned treatment of "Public Purpose," *People vs. Salem,* 20 Mich. 452—one of the classics on the subject,—are none too strong:

"It reaches to every person, to every kind of business, to every species of property within the commonwealth. The conduct of every individual and the use of all property and all rights are regulated by it, to any extent found necessary for the preservation of the public order, and also for the protection of the private rights of one individual against the encroachment of another." He might well have rounded out the picture by saying, and the conservation of any other of the rights of man in his individual and communal state.

Manifestly from what has been said the police power, while the most powerful instrumentality for good when properly exercised, is the most powerful for oppression when not so exercised. History is illumined with its accomplishments and is distressingly clouded by its activities as well. That was appreciated by the wise men who designed the general outlines of our American system of constitutions and their greatest study was how to secure the maximum of its benefits with a minimum of its dangers. Exercise of it, unbridled by the safe barrier of reasonableness, all things considered, and attempted conservation of human rights might run mad at the peril of such oppressive taxation demands upon the people as would vindicate the maxim that "the power to tax is the power to destroy," and might subvert the very purpose of civil government, leaving those sacred rights we cherish so much no longer existent in fact; only surviving in theory and memory. In its possibilities, whether the form of government be based on theory of individual rights or of mere privileges—lurks the menace of socialistic, autocratic, bureaucratic and paternalistic despotism. Though in its nature paternalistic and beneficent and, when exercised within the field of reason, capable of inestimably promoting the general good, the suggested dangers of excessive exercise were so well appreciated when our system was created that the people set up for themselves definite standards of disability and a judiciary on the watch tower clothed with the power and the duty to save the good by the constitutional test and condemn the bad, always resolving all reasonable doubts in favor of legislative wisdom.

The court approaches its most onerous and delicate task in the field suggested when called upon to decide whether a fundamental restraint has been overstepped because of abuse of discretion. Not abuse in the sense of any intended violation; nothing of the kind is harbored in thought; but abuse in the legal sense. Between the to some extent reasonable and necessary and so conservative of rights, and the unreasonable beyond any fair doubt, and so tending to impair or destroy rights, there is a very wide field of definiteness, bordered by a very large margin of more or less uncertain ground, the within being supremely under control of legislative judgment until the reasonably uncertain border land shall have been passed. Then the court cannot escape the conclusion that the paramount law condemns. *State vs. Redmon, supra; Marbury vs. Madison,* 1 Cranch, 137.

Now we have arrived at the very vitals of the question under discussion. Where reasonably necessary the conservation of forests and conservative reproduction of them has been, time out of mind, one of the well recognized ways of promoting the public welfare. History is replete with examples of it, literature affords much that is interesting and instructive in reference to it, and the beneficence of it is evident where there is need for, to the commonest understanding. So activity in that regard is manifestly within the field of police power. Whether a particular enterprise, ostensibly or in fact, to promote public welfare is a legitimate subject for exercise of such power, unless barred by constitutional limitations, is wholly a judicial question. The idea that everything is within the police power which promotes public welfare or which the legislature may say is within it was born of the idea that such power is without fundamental limitations and passed out of sight with the death of that heresy. The court must say the word as to subject, whenever properly interrogated in respect thereto. As early as ***Marbury vs. Madison,*** 1 Cranch. 137, that was declared by Chief Justice MARSHALL, speaking for the Federal Supreme Court. It has been most emphatically since, there and here and elsewhere, affirmed. If a statute, although ostensibly passed to promote the common good or in good faith, but through mistake, enacted for that purpose "is a palpable invasion of rights secured by the fundamental law, it is the duty of the court to so adjudge and thereby give effect to the constitution." ***Mugler vs. Kansas,*** 123 U. S. 661.

It must be understood that, whether a particular subject concerns the public welfare is not the sole test of whether it is a proper one to be dealt with under the police power. That question being answered favorably to the exercise, then the inquiry is presented, Do the interests of the public generally or reasonably call for the interference? That being also answered favorably and the field of legitimacy of purpose will have been passed and that of appropriateness and reasonableness of means will have been reached. The legislature furnishes such means. What is appropriate and what is not, what is unduly oppressive and what is not, is within its discretion to determine within a wide range; but the means must be reasonably adapted to the particular end and must not be so burdensome as regards private rights as to outweigh any reasonably probable benefit from the interference. *Lamberton vs. Steel,* 152 U. S. 133; *State vs. Redmon,* 134 Wis. 89; *Ex parte Jentzsch,* 112 Cal. 468, 472; ***Bonnett vs. Vallier,*** 136 Wis. 193.

The court in the Federal case put special emphasis on the idea that not everything is within the police power which promotes public welfare, and spoke words of caution as to the dangerous tendency of giving legislation the cast of legitimacy by the character of the label and of approving because of the mere fact that in some degree the enactment might be said to promote public welfare. Such a course tends to a multitude of interferences practically destructive of private rights.

The rule as stated by the text writers has been approved here and elsewhere. So the subject must be legitimate, within the limitations stated. That being for the court to determine, then the means must be reasonably adaptable to deal with the subject and not prohibited. Those all satisfied for this case we are then at the threshold of the subject of the means to render the activity practicable within the constitutional meaning of the term "expenses of the state."

Now what would be reasonable in any particular field would depend upon circumstances. What would not be such in the early days of the commonwealth when everything was in a primitive state, burdens of taxation more than to care for the real necessities of civil government were all that could be borne, the state was wealthy in its forests, lakes and rivers beyond comp~~en~~rehensible danger of diminution,—any danger in that regard so remote as not to be appreciated or seen at all and the paramount thought of all being agriculture, manufacturing and development in a way which meant destruction upon the one hand for conservation upon the other, might not be such now, if conducted with some degree of moderation, but that, of course, would exclude the doing of anything expressly prohibited by the fundamental law.

From the foregoing it will be appreciated that reforestation activity, in an old and thickly settled country where necessity, in the near future, for increase of fuel supply and for storing and equalizing the flow of natural waters is apparent, would be quite reasonable, the degree of activity and weight of public burden being in some rational degree proportionate to the exigencies of the case. In a country, more than half its territory unseated lands, in the whole sparsely settled and with no congestion probably for a long term of years, wood fuel in abundance within reasonable reach in that portion of the country which could be thus served more economically than with other fuel; little or no economy in prospect in the use of local timber supply for building purposes, and the natural conditions as to natural surface water supply quite ideal,—to conserve and increase forest products at public expense solely for the benefit of the people of the future, and under such conditions that the benefits would in the remote time be as likely to go to those outside the taxing jurisdiction as to those within it, would seem to be, at best, a great stretch of the police power.

The foregoing, without discussion, or application, definitely, to the particular situation, suggests that, while reforestation and afforestation is within the scope of police power and, to that extent as well as for the conservation of trust lands, such work is a legitimate subject of state expense, within the meaning of the constitution,—there are limitations which should be observed in a country like ours. There are the inherent restraints upon the exercise of the police power and the express limitations of the constitution besides. It does not seem difficult to conclude that there might be such excessive use of public money as to transcend the broadest reasonable scope of the police power, both as to legitimateness of purpose and appropriateness of means, and there might be activity of such nature as to invade the field of works of internal improvement.

The precise legitimate scope of forestry industry, it is not our province to here suggest. It would be impossible to do that so as to mark any definite unmovable line. The scope may contract or expand with material changes of conditions. The best that can be done is to state general principles and apply them, by process of inclusion and exclusion, to the particular situation we have to deal with and leave the rest to legislative wisdom, with assurance of there being no danger of the result being judicially disturbed so long as it does not, convincingly, appear to exceed, beyond a reasonable doubt, the field of legislative discretion. Such general principles, perhaps, have been sufficiently stated. They have been in some respects applied to such situation, but to clear up any uncertainties which might arise in the mind of any one having occasion to study the discussion here, it may be well to restate and add to, with particular reference to our statutory scheme.

Of course, the fundamental limitations of legislative authority as regards diverting lands impressed with an exclusive educational trust, or the moneys, arising from lands fundamentally dedicated to such a trust, to independent forestry or to any other purpose, or diverting lands of the swamp grant class so that moneys arising therefrom, not used for the primary purpose of such grant, will not inure to the secondary trust under the state constitution or invade the constitutional authority of the Commissioners of Public Lands over "school lands proper" cannot lawfully be overstepped. Any activity beyond those barriers is outside of legislative discretion.

Whatever is reasonably required to care for the trust land of any character, as regards fire hazard or trespassing or realizing on annual forest crops, naturally produced thereon and to utilize the dead, down, dying and mature timber for the benefit of the fund for which the lands are held, may doubtless be done and at general public expense, if the legislature so wills, and referable either to the police power or the governmental function for which the lands are held. Neither police nor any other power would justify use of public money and, so, the taxing power, in the purchase of land for forest or any other purpose and administration thereof so as to prejudice the proper handling of the trust lands, either by lessening the proceeds which might otherwise be derived therefrom, or income thereon, or confusing the proceeds, or the income thereof, belonging to one fund with those belonging to another.

Probably conservation of the trust lands under the police power for the particular purposes of the trusts, might include judicious purchasing of adjacent lands to protect the former and increase the proceeds therefrom in the end; the investment to remain a part of the trust where the ultimate benefit is to be state wide, as in case of lands held for educational purposes, or returned to the general fund in case of a sale, as the legislature might determine, and in case of the lands being subject to a trust for a local use, as for example drainage, the investment returned to the general fund in the event of a sale. Under the particular power, doubtless, there is a wide field of legitimate activity as to policing to prevent and protect against fire loss in the wooded portions of the state, or loss from fires originating on unoccupied lands, or liable to spread with dangerous consequences to other lands.

Probably, too, under the police power, expense may be incurred to properly care for the quite large amount of lands granted to the state for forestry purposes, and they may be added to at state expense for the primary purpose of utilizing the particular lands and making them valuable in an educational way and for the public purposes of the grants. The primary purpose would not be to create a forest reserve either as a temporary or a permanent feature of the state and, so, violate the inhibition against engaging in ''works of internal improvement;'' but would be for the public purpose of realizing upon the granted property for the purposes of the grant. That would seem to be well within the field of public welfare and not contrary to any fundamental limitation. The cost then would be legitimate ''state expense'' within the meaning of the constitution. The legitimacy of that would not be militated against because of the incidental effect being to create a permanent forest reserve, if such were the result, and if caution were taken to keep the primary purpose of the public investment within reasonable bounds and conservative of the donated property for the educational and other purposes of the grant.

The primary purpose in making purchases to block up with lands presently held should be conservation of the particular class of lands and the administration should be on that plan, in order not to run any risk of violating express or implied fundamental limitations and bring the expense within the meaning of ''state expense'' in case of there being no provision for returning the outlay, reasonably, to the general fund.

Thus it is logically considered that, restrained as before indicated, the forestry work, in general, mentioned in sec. 1494—41 to 1494—62, inclusive, with incidental appropriations out of the state treasury to pay for the same as state expenses, if the legislature so wills, is legitimate. There must be excepted, lumbering operations, sales of timber or other products of the trust lands other than for enhancement of the school or other appropriate fund according to the class of land yielding the same, expenditures for the purpose of making the lands, as such, of permanent use to the state in the general sense. While the trust lands may be leased or used otherwise than offered for sale they cannot be tied up permanently for the benefit of forestry or at all except for the primary purpose of producing the results contemplated by the Constitution. For that they may be withheld from sale, in legislative discretion. That discretion may favor one way of handling the land at one time and a different way at another. The language of the law in terms that they may be handled with reference to a permanent benefit, in the general sense, as if held in a proprietary capacity goes too far but does not hurt because not binding. The proceeds of or moneys arising from the land cannot be used otherwise than as the Constitution provides nor the lands used otherwise than with a view of acquiring such proceeds or moneys.

The prime difficulty discovered in this case is the disregard of the Constitutional dedication of "the proceeds of" and "moneys arising from" the trust lands which has been in progress since the law of 1897, causing almost inextricable confusion of "school lands proper" with second class school lands, drainage lands, lands purchased from the proceeds of, or moneys derived from, such land, and other classes of lands and further confusion of such proceeds and moneys and moneys arising from the purchased lands. That confusion must have been intensified by the practice of swapping land and other activities, all the operations involving, with the receipts from lands since the forest diversion took place, a million dollars, more or less, say nothing about interest.

The confusion spoken of will require a most careful accounting to determine the legal and equitable status of the claims of the trust funds upon the general fund, and the relations between the school fund and the drainage fund, and of both with the forestry fund, and a judicial confirmation as a closing administrative matter in executing the judgment in this case.

Now whether, in the light of the foregoing, there is any reasonable call for the large appropriations characterizing the particular scheme,—a significant part being the fifty thousand dollars per year depended upon to pay out the land contract claims,—in view of the present development of the state, need not be decided, because the supposed condition under which the legislature created the plan and which the forester, as we see, has advised carrying out to an extent which would absorb several millions of dollars, would doubtless not have been thought of, had it not been supposed that the domain belonging to the trust fund purposes could be laid hold of as a foundation for the permanent forestry investment. It is easily seen that it would require a very large investment to purchase all the lands required to realize the ambitious plan. The estimated amount of lands, in the whole, according to the report of the Forester, would be around a million acres. All was designed to be treated in a proprietary way by making improvements of various kinds and carrying on business with the improvement of water powers in prospect. The entire investment contemplated, including withdrawal of all the trust lands so as to make them a permanent feature of the state for its general purposes as suggested in sec. 1494—43 sub. 2 and withhold them from private ownership and of present use for the ordinary public functions of the state government,—would be three million dollars, more or less, a large part of which must belong to the educational funds of the state; but permanently diverted therefrom contrary to the most emphatic dedication thereof by the people in the beginning.

As clearly seen, the sacred trust lands were the basis upon which the whole structure we have considered was builded. After the practice for several years without question, under the supposed law of 1897, which in fact did not exist, except for a brief period, of treating the lands which had been for more than thirty years in charge of the Constitutional commissioners under the fundamental law, as free lands which the legislature could do with as they saw fit, that it came to pass, by 1903 and 1905, that the true character thereof was lost sight of or ignored, is not to be wondered at. There were several changes of officers during the period mentioned, both as to Commissioners of Public Lands and officers who were supposed to give special attention to the school fund for the benefit of which the state held the trust lands; but just how it came about that none of these guardians came to its rescue until the present Commissioner raised the protest which resulted in this litigation, it is not our business to inquire, though in the public interest which is now so within our judicial authority to conserve, we may properly mention the seeming omission as one of the things which gave rise to the false conception in the light of which the legislature created the scheme for a permanent forest reserve with the trust land as the substructure and the constitutional guardians of the "school lands proper" and who had theretofore been entrusted with the care of the other state lands relegated to a very inconsequential position. In the new light as to the trust lands, and the situation which must necessarily considerably restrict the forestry activity and scheme, the legislature will doubtless recast the plan in respect to the matter and carefully eliminate from the statutes all illegalities and such excesses as there may be in the light of this decision.

XI.

It is perhaps rightly thought that section 1092m Stats. (Chap. 740 Laws of 1913,) is so involved in the forestry scheme of which the primary matter of this litigation is a part, that it should be considered with the other details of the entirety.

We will do that, because it seem that, necessarily, such litigation, as broadened, takes in all the details of the forestry scheme to the end that a single decree may settle the entirety.

Is the statute referred to constitutional? It provides for:

1. Filing by the State Forester each year with the Tax Commission of a list of all forest reserve lands in certain counties and portions thereof.

2. Assessment of such lands for taxation by the Tax Commission.

3. Placing of such lands on the local tax rolls for local taxation; the tax burden to be limited to one and one-quarter of one per cent upon the assessed valuation.

4. Payment of the tax out of the general fund of the state.

5. Reassessment under §1087—45 Stats. Also appeal from the equalization by the county board under §1077a to §1077—1 Stats.; the assessor of incomes of any county where any of the forest reserve lands are situated to possess the right to institute proceedings for reassessment by the Tax commission of all taxable property in any town where any forest reserve lands are situated and institute proceedings for a review of the relative value of the taxable property of the taxing districts where said lands are situated.

That certainly is quite a novel piece of legislation. It seems to be fatally infirm in treating the lands as proprietary property. It will be observed that the state consents to the taxation on that theory. Had it been appreciated that the state's title was of a trust character, the legislature would probably not have so provided. It is not perceived by what right the state can deplete the general fund for the purpose of paying local taxes on its trust lands. State revenue can only be used for state purposes of a governmental nature, as we have before seen.

Again, if the trust lands may be made subject to local taxation, why does not the act violate the constitutional provision that the rule of taxation shall be uniform? Sec. 1, Art. VIII. Under this act, the trust lands in certain counties and portions of counties are made subject to local taxation, while the same kinds of lands elsewhere are not.

Again, why does not the act violate the constitutional plan of local self-government, in that the original assessment of the property for taxation is required to be made by the state Tax Commission instead of by the local assessors, and the whole scheme ignores the right of local control and the law requiring uniformity of rule of taxation. That applies, so that, while the doctrine of classification is recognized the rule of taxation within each class must be uniform. If the trust lands are to be taxed at all, all the lands of that character must be taxed. All church property may be exempted from taxation; but to subject such property to taxation as to some church organizations or in some counties and exempt like property otherwise would be clearly unconstitutional. That would not be unlike taxing some of the trust lands because they are in the forest reserve and leaving the others not so burdened, thus affording towns in which lands of the first class may be situated in possession of a special advantage.

Again, it is not perceived why this taxing statute does not violate section 1, Art. IX of the constitution prohibiting special legislation for the assessment or collection of taxes. The act is special in every respect. It applies to but part of a class of land. It provides for assessing such part in a special way and for a particular class of tax burdens. It provides for taxation within a specified limitation as to amount. In the whole, it is difficult to conceive of anything which could be added to the enactment to emphasize its character as a piece of legislation of special nature for the assessment and collection of taxes. The constitutional provision reaches the whole subject of taxation and every part of it. *Kimball vs. Rosedale,* 42 Wis. 407; *Chicago & N. W. Ry. Co. vs. Forest County,* 95 Wis. 80; *State &c., vs. Hazelwood, et al.,* 158 Wis. 405.

The various infractions of the fundamental law are so clear that it seems unnecessary to cite authority in respect thereto. The enactment seems to have been framed to meet an emergency supposed to be very pressing. The supposed exigency seems to have overshadowed entirely the fundamental law, preventing devotion to the proposition of the real official discretion and judgment which should be applied to such matters. The remedy suggested was accepted. An act in relation to a subject so closely fenced about by fundamental law as that of taxation should be scrutinized by legislators with the greatest possible care, and reasonable doubts as to its validity should be resolved in favor of the constitution. To enact proposed legislation without such care and in case of doubt as to constitutionality pass it regardless thereof, with the thought that it may never be judicially questioned and, if it shall be, the point of view will be reversed and the act sustained, unless found to be manifestly unconstitutional, is to greatly minimize and in some features abrogate fundamental law.

XII.

Are sections 1494—132, 133 and 134 constitutional? They are part of the whole which is involved in this litigation. They provide:

(a) No county which is wholly or partly north of town 33 shall take a tax deed except upon condition of filing with the commissioners of public lands a list of the deeded lands, the date of the deed, record thereof and amount of the county investment in such lands.

(b) A county which shall have taken a tax deed in such territory shall not sell the land for one year, except to the state, unless duly notified that it does not desire to acquire the same.

(c) The Commissioners of Public Lands may take such of said lands for the state as they may desire to so take within the year period and, at not to exceed the cost to the county, the purchase price to be paid out of the general fund.

(d) As to lands so taken a former owner is accorded the benefit of the statutes as to regaining the property by judicial remedies except as to recovering costs in case of being the prevailing party.

The special nature of such provisions is plain. Under the general system of county government, the taking of tax deeds by counties on matured tax sale certificates owned by it, is obligatory. The deeded land, in any such case, becomes county property as absolutely as in case of a tax deed by a private person. Until the county chooses to sell the land, not exceeding two years, it remains subject to taxation, in which case the county must pay the local and state taxes and take the certificate on the sale as an additional claim against the land. It cannot be sold except by order of the county board and at such price as it may determine. It may be more or less than the county investment. The county may demand the full value thereof the same as a private owner might. In that way it has competency to make up on excess sales what it loses on others. (Sections 1193 and 1194.) The whole is an important part of the system for the collection of taxes by counties for their benefit and that of local taxing districts and the state as well. The enactment seems to pretty clearly violate the fundamental requirement for uniformity of town and county government. There can be "but one system of town and county government, which shall be as uniform as practicable.." Sec. 23 Art. IV State Constitution.

In general, as indicated, counties may handle their tax lands in their discretion, subject to the limitation as to taxing. To take away that right in the particular counties—remove the lands, practically, at once, upon a tax deed being taken by the county, from its taxing resources and those of the towns as well and appropriate the same at the cost to the county of the particular lands, regardless of the real value, and the actual cost as well, in the general sense, specializes to a high degree to the prejudice of such counties and taxing districts. The scheme violates the prohibition of special legislation for the assessment and collection of taxes.

Land once acquired by a county is, as to the state, private property. The latter has no interest in it whatever. Therefore, for the state to appropriate it in the adversary way designed, violates the prohibition against taking private property for public use without rendering just compensation therefor. That applies in case of the state taking property which a county owns in its proprietary capacity, the same as in case of its taking property from any other person.

The feature affording a former owner less advantages as to regaining his property than owners, in general, violates the fundamental rules of equality.

We have now covered all questions suggested in the case. We need not add a recapitulation of conclusions. They appear sufficiently in the opinion to render a résumé, other than what will be embodied in the order and judgment, unnecessary. That will be subject to an accounting to be had and the approved result embodied therein in due time. The judgment must respond to the situation that the whole case, as to pleaded facts on the part of the defendant, is admitted, rendering opportunity to plead over not needed. Because of the broad character of the issues framed under suggestions of the court, the submission and desire for all involved to be set at rest, the closing must be correspondingly broad, taking much the cast of a decree in equity, as in *Will of Rice*, 150 Wis. 401; *State vs. Northern Pacific Ry. Co.* 157 Wis. 73.

On account of the unwarranted confusion of different classes of trust fund lands with lands purchased by proceeds of trust fund lands and other moneys, including money drawn from the general fund, and income from trust funds, and other confusions, all must be regarded as having the cast of trust fund lands and money so far as necessary to the full restoration of such trust fund lands and property, and identification of the amount belonging to each fund as of the date of Chapter 367, Laws of 1897, and further back if found practicable.

By the Court: It is considered, ordered, decreed and adjudged that:

First. The demurrer to defendant's pleading be and is overruled.

Second. The land contract mentioned in the petition is void for reasons indicated in the opinion, particularly because:

a. It created a state debt and created such when state indebtedness exceeded the constitutional limit.

b. It is an evidence of indebtedness within the state constitutional prohibition.

c. The contract was not authorized by statute.

d. By Section 10, Art. VIII, at the date of the contract, it is fatally within the "works of internal improvement" feature of the forestry statutes (though they are in important features, as indicated in the opinion, not so tainted) and the addition, in form, to such section in November, 1910, failed for reasons stated in the opinion.

e. It is an inseparable part of the forestry legislation and particularly of the invalid features thereof stated in the opinion.

Third. The forestry legislation, including section 1072—1, Chapter 367, Laws of 1897, Chapter 450 Laws of 1903 and Chapter 264 Laws of 1905, and such other acts as there may be, did not repeal or affect sections 250 and 251, Stats. 1898, for reasons cited in the opinion. Such sections are part of the written law of the state and govern the matters therein referred to.

Fourth. All land derived by the State from the United States under the swamp land grants, the lands in lieu of swamp lands, set aside for educational purposes under Chapter 537, laws of 1865, and confirmed by Chapter 151, laws of 1869 and subsequent practice, and all other lands so derived or in lieu of swamp lands and required to be set apart under the terms of said sections 250 and 251, by section 2, Art. X of the constitution and the legislative action referred to became, and so far as not disposed of are, school fund lands, as regards the manner of handling the same, subject to the constitutional duty to conserve the same for the purpose of producing money for the school fund, as indicated in the opinion; but under the control of the legislature in respect to the manner of dealing therewith for such purpose.

Fifth. The sections of the statutes composing Chap. 740, Laws of 1913 and those composing Chapter 491 Laws of 1907 are unconstitutional for the reasons stated in the opinion.

Sixth. The provisions of the forestry legislation, other than the features mentioned, are valid within limitations stated in the opinion.

Seventh. The State has an equitable lien on the lands included in the illegal contract for the money paid thereon, and such money, equitably, is declared to have been trust money, whereby such lien inures to the benefit of the trust fund property.

Eighth. For the benefit of the trust funds, the balance due on the contract shall be paid out of trust fund money when practicable and to provide therefor, all moneys to the credit of the forestry fund derived from sales of land, or from appropriations to buy lands, or in the tax title fund referable to sections 1494—131 to 135 inclusive, Stats. 1913, are declared to equitably belong to the drainage and constitutional trust funds. Because of the diversion of such funds to forestry purposes and to the general fund, and the resulting confusion, the whole is declared to have the character of the more important funds which have wrongfully lost their identity, and such equitable status shall subsist so far as necessary to fully remedy the diversion and confusion.

Ninth. The newly acquired lands under the forestry law, except those donated to the state for forestry purposes, have the cast of the constitutional trust fund lands and will be administered accordingly until, upon a full accounting, it shall be found what part, if any, will remain after fully restoring the integrity of the trust fund lands and trust funds.

Tenth. The facts being admitted, the alternative writ of mandamus is dismissed, but the cause retained for the purpose of final disposition upon the coming in of the report of the referees hereafter appointed.

Eleventh. There shall be an accounting which is hereby ordered of all dealings with the trust fund lands of the date of Ch. 367, Laws of 1897, and so long prior thereto as practicable, not earlier than the decision under Chapter 537, Laws of 1865,—and of lands acquired under the forestry legislation since 1897, except those donated to the state for forestry purposes or acquired by proceeds of the latter, and an accounting of all proceeds of such trust lands and income thereof and income which such proceeds would have earned had the same been devoted to the trust to which they belonged, such accounting to include all moneys paid into the forestry fund or general fund, derived from trust fund lands or lands purchased therewith and income from such proceeds, and a partition shall be made of the entire property so found equitably and legally to belong to the constitutional trusts, including any indebtedness from the general fund; giving due credit for all proper disbursements chargeable to such trust funds,—so that each of the constitutional trusts will have their equitable and legal portion of the trust fund property with identity established as to lands and other assets, as near as may be, after the manner of the decision under Chapter 537, Laws of 1865. Such accounting shall include all matters not specifically mentioned so far as necessary to cover the field discussed in the opinion and carry out the intent thereof guided by such opinion, and the referee shall report the result of the accounting to the court with all convenient speed.

For the purposes of the accounting the cause is referred to the Commissioners of Public Land and Judge Samuel D. Hastings as special referee.

The holders of land contracts like the particular one shall be bound by the decision herein subject to the right of any vendor or assignee of such vendor to show cause why to the contrary within twenty days after service of a copy of this order on such vendor or assignee and notice to show such cause within such time or be so bound, and such notice in writing shall be given, so far as practicable, within twenty days after the entry hereof and proof be filed as part of the records of this case.

Administrative orders will be accorded, if necessary, for further guidance in the course of the accounting, to the end that this determination may be fully carried out according to the intent thereof.

Upon the coming in and confirmation of the report of the referee judgment shall be rendered in respect to the matters covered thereby in accordance with such confirmation.

5

The Social Anatomy of An Agricultural Community

C. J. GALPIN

INTRODUCTION

Everybody now recognizes the existence of a distinct country problem. Who has not heard with more or less alarm of the steady decrease of farm populations and the rapid growth of cities? City consumers and farm producers have at least seen the problem from their respective points of view.

Many remedies have been advanced and several well-defined movements have been started for the improvement of country conditions. These different solutions have, however, been set forth in the main without a preliminary study of the interrelations of the farmer and townsman. Such a study is here presented in the survey of a Wisconsin county. It was hoped that the inquiry would cast some light upon current rural problems of education, local government, and religion. Walworth County was selected because of its having no large city to complicate the problem. Besides, it is one of the oldest counties in the state, and is generally regarded as typical of the older farming districts of the state. The survey was very limited in its character, being organized specifically to find out how the village or small city plays its part in the life of the farmer and his family.

A new rural and urban point of view has grown out of the attempt to answer satisfactorily the following series of questions: Is there such a thing as a rural community? If so, what are its characteristics? Can the farm population as a class be considered a community? Or can you cut out of the open country any piece, large or small, square, triangular, or irregular in shape and treat the farm families in this section as a community and plan institutions for them? Would the eighty-five farm homes in a Norwegian settlement, bound together by one church organization, form a community? Has each farm a community of its own differing from that of every other? What is the social nature of the ordinary country school district? What sort of a social unit is the agricultural township?

Suppose that you are on the summit of Blue Mounds, Dane County, Wisconsin, overlooking the great stretch of dairy country to the east, south, and west. Farm industrial plants, each with its close-set home, embroidered with trees, form distinct patches all over the landscape. But at distant intervals a much larger patch appears. You say, "There is the village of Blue Mounds; yonder is the village of Mount Horeb; over there is Barneveld." What is the relation of these villages to those farm plants? Are the villages communities by themselves? Can you safely treat them socially as complete units? How are they related to each other? What is the real meaning of these pictured human clusters?

Is it possible that the farms are related to the village clusters in such an intimate way that in any serious treatment of the one the other must be taken into account? May there not be an important social anatomy here, which needs careful tracing as a factor in any rural social reform? Have we assumed hitherto that the interrelations of farm and village or small agricultural city are all on the surface and easily read? Would it not be well, before imposing a redirected civilization upon the country man, to examine more minutely the larger movements of his ordinary life?

PART I

A SOCIAL SURVEY OF WALWORTH COUNTY, WISCONSIN

The Method

Large working maps of the county.—A recent atlas of Walworth County was taken to pieces, the township maps on a scale of two inches to the mile were assembled in order, thumb-tacked on a large board, and reproduced on tracing cloth. From this, blue prints were made on cloth, freely used and cut into field maps as required for surveys. The county is twenty-four miles square.

Assistants resident in each village.—A visit was made to each of the twelve villages and cities of the county, and an assistant selected to aid in taking the survey. Teachers, high school principals, clergymen, bankers, and librarians finally composed the staff of helpers.

Getting a land basis map.—Each village or city was to be the center of information and the problem in general was how far out among the farm homes the village served any social purpose. From the point of view of the village, the problem was one of getting at the land area of village influence; from the point of view of the countryman, it was learning what farms were connected with the same village.

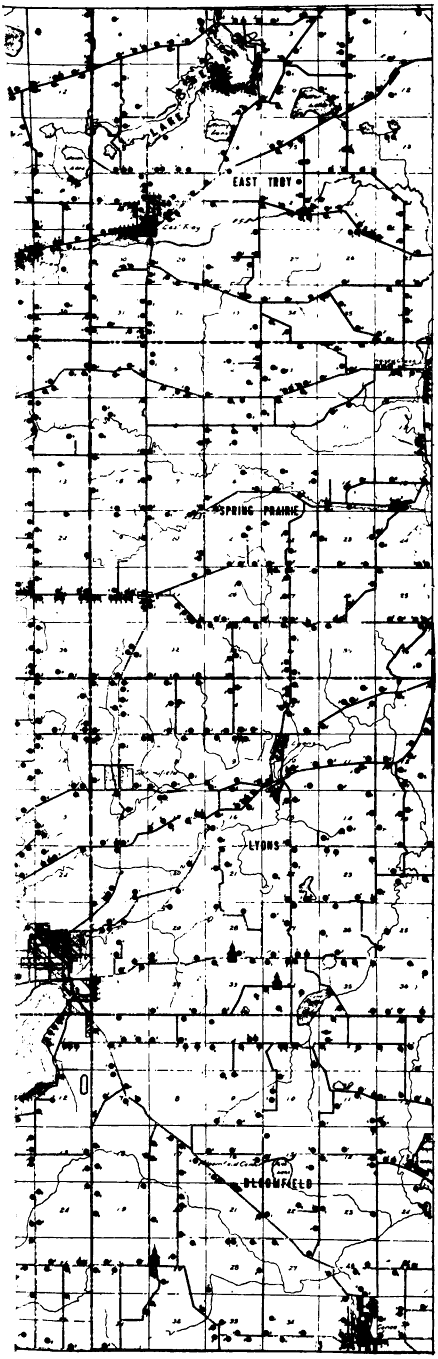
A visit by the survey-maker to the leading dry goods merchant with a print of the county map spread before him, got an answer to this question: "Which are the farm homes, north, south, east, and west, that come farthest to trade in your village?" The result would be a tentative rough trade line drawn about the village. Next the banker would indicate the long-distance farmers coming to the village to bank. A visit for confirmation would be made at the village milk factory, grocery stores, and the like. Then a local map was cut out of the county map one mile wider and longer than the trial limits set. This became the working map for the area having the village as center.

Twelve civic centers surveyed.—Not all of the hamlets and smaller villages were surveyed. Twelve villages and cities were selected: Darien, population (1910) village and township 1,249 (village probably about 500); Delavan city, 2,450; East Troy village, 673; Elkhorn city, 1,707; Genoa Junction village 709; Honey Creek village, not incorporated, about 200; Lake Geneva city, 3,079; Millard, hamlet about 75; Lyons, not incorporated, about 500; Sharon village, 879; Walworth village, 755; Whitewater city, 3,224. This selection gave in the same class of small cities, Delavan, Elkhorn, Lake Geneva, and Whitewater. Though under city government, and under the impetus of city ideals, these centers are still fundamentally agricultural, and of village type. A few industries of city type are beginning to prosper in these centers. Of the typical village type, still without city ambitions, are Darien, East Troy, Genoa, Lyons, Sharon, and Walworth. Honey Creek is nearly of village type. Though small in population, it has a bank, a one-year high school, lumber yards, and railway transportation. Millard is a neighborhood center of the one-store type, with a milk factory, school, and one church. It was selected from among many others in the county because of its availability, and its typical character.

Survey schedule.—The survey problem of the county resolved itself from this point on into twelve separate surveys, each one carried on practically like every other. Printed blanks, one for each farm home, as spotted on the map, were given to the resident survey-maker. The schedule blank follows:

EXPERIMENT IN RURAL COMMUNITY SOCIAL ZONES

Name of village..
Name of farmer..
Township..
Section..
Number of farms in section..
Banking..
Dry Goods..
Groceries..
Milk to village factory..
High school in village..
Church in village..
Village paper..
Village library..



ages. Distances are indicated by section lines
rial symbol.

With the local map and a package of schedule blanks the survey-maker began to gather the facts.

Gathering the facts.—The first requirement was the name of the farmer residing on each farm represented on the map. In some cases this meant the gathering of 600 names. Usually the banker, real estate man, livery man, and physician in the village could give the bulk of the names. The telephone helped with the remainder. The result was a card catalogue of all farm homes on the map, typewritten on the schedule blanks, one blank to each farm home. Each farm home was located on the schedule by township, section, and number in the section, to correspond with the spot on the map locating the home. With this package of names and the map as a guide in case of doubt as to the man, the survey-maker visited the leading dry goods merchants and got an hour to go through the list, and ask the question, "Does John Doe buy dry goods regularly in this village?" If he does, a cross is put to his account in the blank opposite "dry goods."

In like manner, a visit is made to each grocery, bank, milk factory, village paper, village clergyman, high school principal, library; and from the records as matters of fact, and not of opinion, it is indicated on the blanks which homes are connected with the village institutions. In case of the high school, the question was, "Has any one in John Doe's family attended the high school during the last three years?" In case of the paper, "Does John Doe take your paper?" In case of the church, "Is any one in the family of John Doe connected with your church?"

The survey was begun with Delavan in August, 1911, and finished with Whitewater, July, 1913. When the blanks were filled, they were sent in with the map to the College of Agriculture.

Making the final maps of the county.—The trade map was made first by merging the dry goods and grocery maps which nearly coincided. A large piece of corrugated paper board was placed under a copy of the county base map. Each farm home trading at Elkhorn, for example, was marked and then a pin stuck in the spot. A thread was run around the outside of these pins, following from pin to pin so as to include the least amount of territory while enclosing every pin. This thread line became the boundary of the trade zone. After the trade zone of each of the twelve centers was marked out in this way, the common territory where zones overlap, with homes trading at more than one village was colored alike and called neutral ground. Each community was given its own color. Then round, white seals were used to designate the homes that were found to use the same trade center. In like manner each set of maps was made in water colors.

THE RESULTS IN MAP FORM

Twelve trade zones.—Surrounding each village or city center is an area or zone of land including farm homes that trade regularly at the center. This zone is irregular in shape, due to such factors as irregular roads, lakes, marshes, and varying distances of the trade centers from one another. No village or city is found in the county without its farm trade zone, and within this zone the number of farm homes closely approximates the number of homes at the center. Accessibility seems to be the largest factor in determining the regular trade center for any farm home.

The trade areas of adjacent centers have a tendency to overlap a little, producing a belt from one to two miles in width, of neutral or common trading territory. Farmers living about half-way between centers have a double, or in some cases, triple trading opportunity. A large and nearly complete trading center like Delavan is likely also to include almost all of the territory around an adjoining small or comparatively incomplete trading center, like Millard or even Darien.

These trade zone lines run, moreover, without regard to the political lines of the township, county, and state. Only one township in the county, viz., Whitewater, lies wholly within one trade zone. Only three of the twelve trade zones lie wholly within the county; while the four zones in the southern part of the county run over into the state of Illinois.

Several trade centers lying in adjacent counties evidently invade the farming territory of Walworth County, especially in the north and east. No account was taken in the survey of these outside centers. Nor were summer resort homes and cottages around the lakes included in the survey, although they appear on the map.

The farm homes in the same trade zone use the four, five or six main roads leading to the village center more frequently than any other extended network of highways.

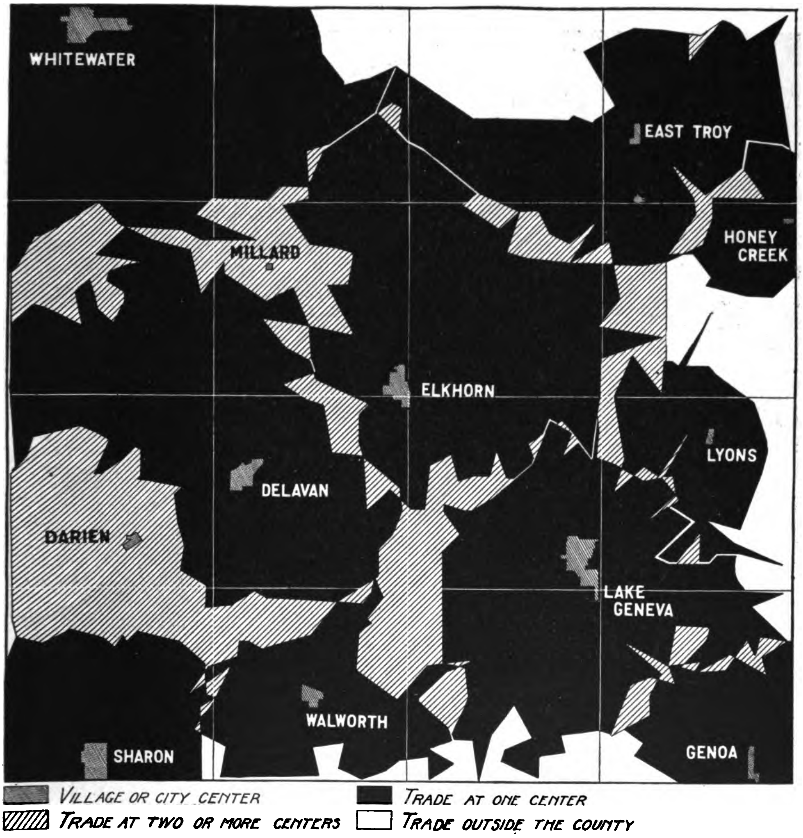


FIG. 2.—TRADE COMMUNITIES

Twelve villages and small cities situated in the county serve as trade centers for the farm homes precisely as for the village and city homes and all the homes trading at the same center form a trade community. Township lines six miles apart indicate the distance.

These families, obviously, have at least a passing acquaintance with one another. At the village they meet casually, at least, with farm families from the whole zone. This trade zone acquaintance at the village center is probably wider for each farm home than any other area of its farm acquaintance.

The trade zones of a county are subject to extension and shrinkage with the growth of village centers in number, size and efficiency. A particularly aggressive business spirit in any center, shown by advertising, efficient methods of buying and selling, may enlarge the boundaries of the zone somewhat or at least widen the neutral belt. The farm homes in neutral territory, which are so situated that they may go to more than one trade center, hold a position of decided advantage in determining trade policies of merchants in two or more competing small cities.

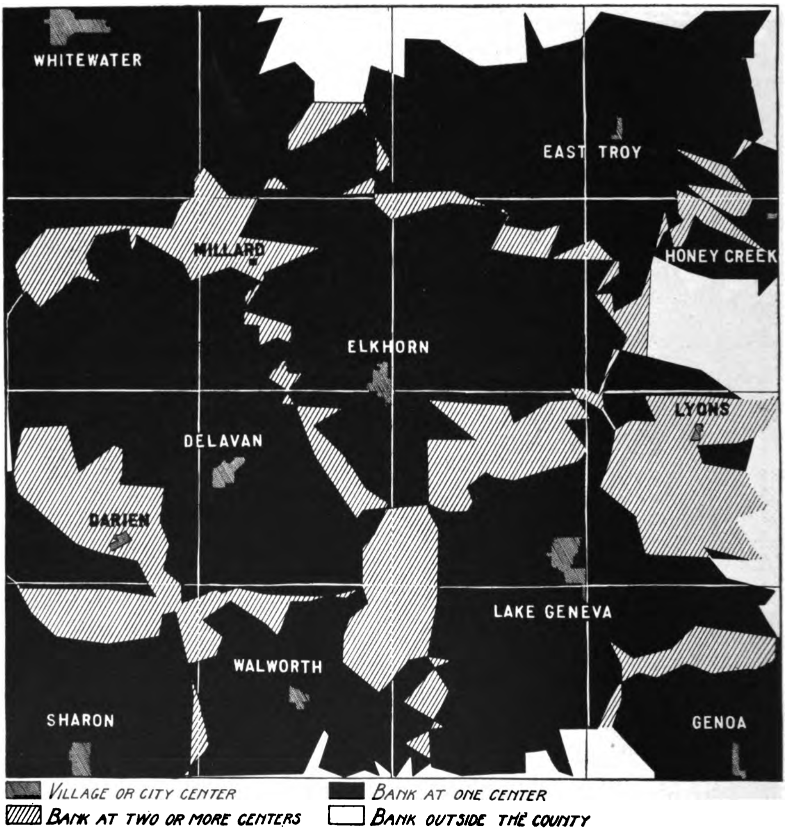


FIG. 3.—BANKING COMMUNITIES

Farm homes use the banks at the village and city centers just as do the village or city residents. The homes banking at the same center form a banking community. Township lines six miles apart indicate the distance.

The village or city homes and the farm homes in the same trade zone have a common interest in the same trade agents to a certain degree, perhaps particularly the grocer, dry-goods merchant, or clothing merchant. Even in cases where these lines are specialized for farm trade or village trade, it is found that the village homes will be patrons of the "farmers' store," and the farm homes patrons of the "city store".

Eleven banking zones.—Like the trade zone, a banking zone of farm homes surrounds each village or city having a bank. The size of the banking zone compares favorably with the size of the trade zone, and ignores township, county, and state lines; has a belt of neutral or common territory; and reaches about half way to the adjacent banking centers. The banks are used all but universally by the farmers, and apparently the bank acts in the same capacity for the distant farmer as for villager or city dweller living within the same banking zone.

As in the trade zones, farm homes in the same banking zone use frequently the same roads, are under the operation of the same factors of efficiency and integrity in bank management; village homes and farm homes in the village bank zone, have an identical interest in bank control and policy; farmers in the neutral belt occupy positions of special power. Honey Creek and Lyons, rather new small banking centers, have begun with a very small exclusive banking territory, creating slowly a neutral banking belt common to adjacent neighbors.

Seven local newspaper zones.—Apparently a local newspaper is a necessity in a complete civic center. Only seven of the twelve centers in Walworth County have newspapers. The paper zone conforms closely in shape to the trading and banking zones, and shows that more than half the farm families are subscribers to this agency of local acquaintance and information. Evidently the village editor and his paper serve the same purpose on the land as among the clustered roofs.

Twelve village milk zones.—The milk industry is organized in the county very generally upon the neighborhood scale, with small creameries and skimming stations scattered through the open country. However, at each of the twelve civic centers is a creamery or condensery run on a scale exceeding that of the open country factory. These milk zones, while following the general lines of the trading zone, are naturally much smaller. Only a little neutral territory exists, and this is due to seasonal shifting.

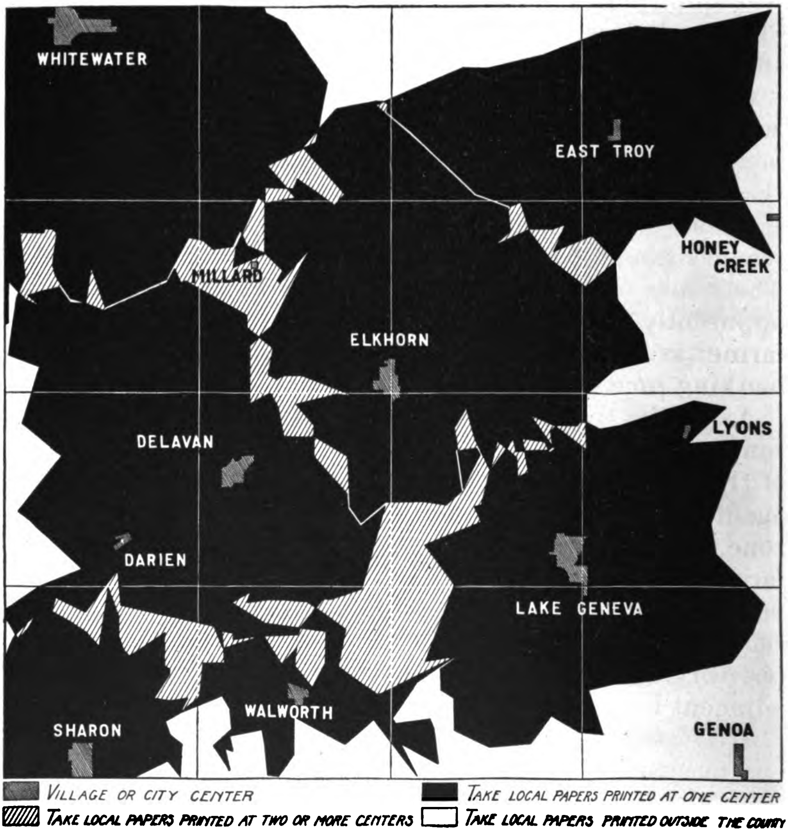

WHITEWATER
EAST TROY
HONEY CREEK
MILLARD
ELKHORN
LYONS
DELAVAN
DARIEN
LAKE GENEVA
SHARON
WALWORTH
GENOA
VILLAGE OR CITY CENTER
TAKE LOCAL PAPERS PRINTED AT ONE CENTER
TAKE LOCAL PAPERS PRINTED AT TWO OR MORE CENTERS
TAKE LOCAL PAPERS PRINTED OUTSIDE THE COUNTY

FIG. 4.—LOCAL-PAPER COMMUNITIES

The homes taking the same local paper form a paper community. Such communities are pretty well defined and conform closely to the trade and banking communities.

A rapid concentration of the milk industry into these village factories, condenseries, and shipping plants is at present a marked tendency. A few years may bring into this county the auto-truck milk gatherer for each of the large village factories—an agency already used in some parts of Wisconsin. These milk institutions at the civic centers, in cases operated and largely owned by outside companies, are industrial plants of a character especially blending the interest of the villager with that of the farmer. Not only the few main roads leading into the center become of critical interest, but every road in the possible milk zone takes on a new social value—an interest which is likely to overshadow the local road district interest or even the township road interest.

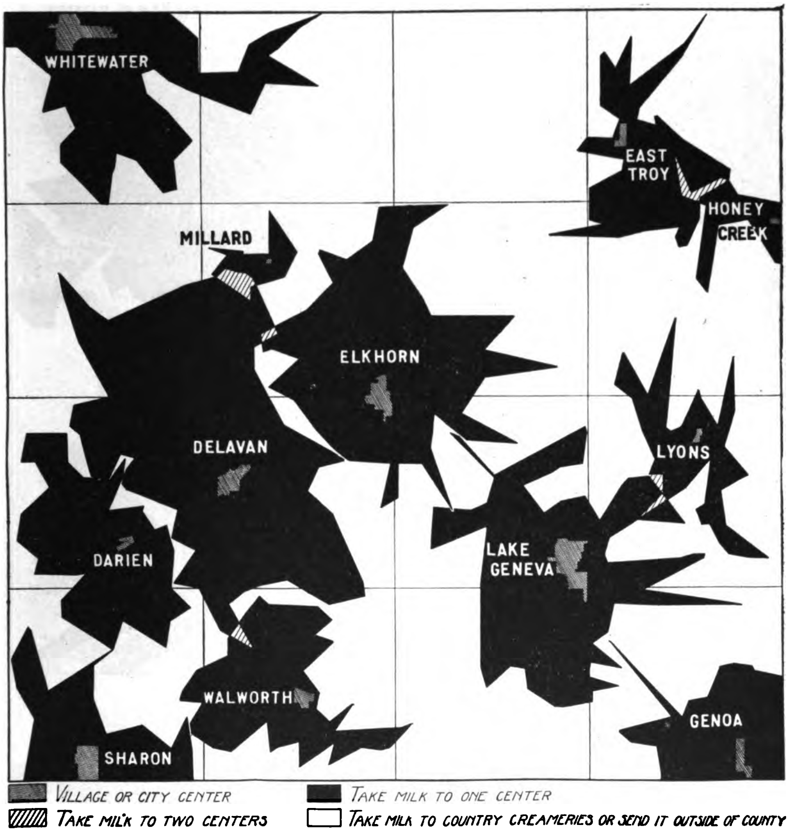


FIG. 5.—VILLAGE OR CITYMILK- COMMUNITIES

All farm homes taking milk to the same milk center form a milk community. Notice the tendency to concentrate the milk industry at the trade centers in this county. Observe the township lines.

Twelve village church zones.—In the open country are many small churches of the neighborhood and race settlement type. Every hamlet has at least one church. Nevertheless the village churches are fairly democratic, and are attended by farm families going distances of five and six miles. It seems to be the policy of the Roman Catholic church in this county to locate its churches in the villages and cities, a fact which makes several of the village church zones of considerable size, almost equal to the respective trading zones.

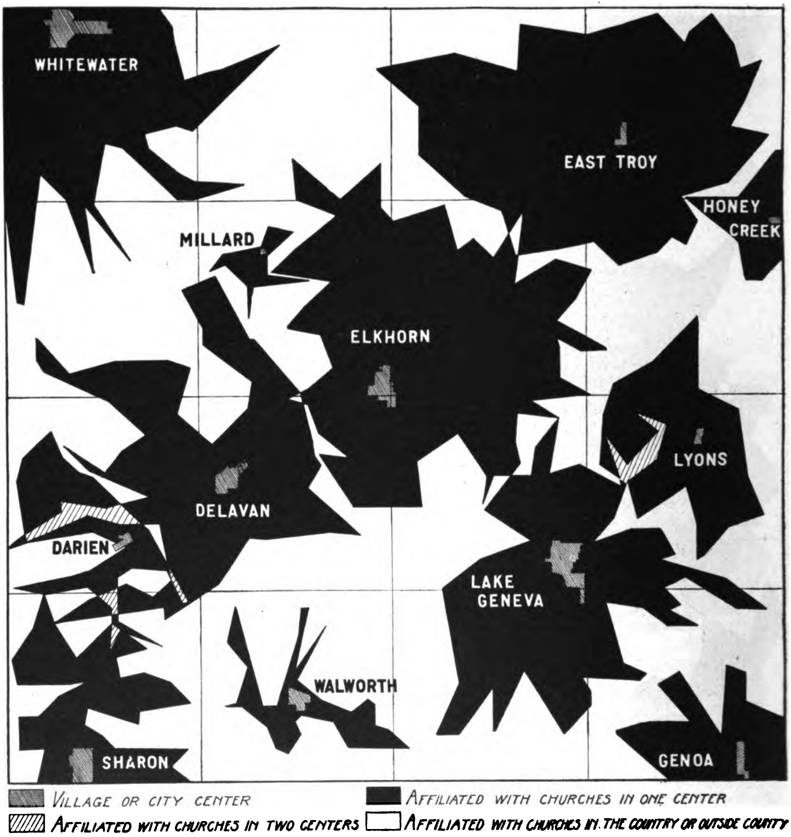

WHITEWATER
EAST TROY
HONEY CREEK
MILLARD
ELKHORN
LYONS
DELAVAN
DARIEN
LAKE GENEVA
WALWORTH
SHARON
GENOA
VILLAGE OR CITY CENTER
AFFILIATED WITH CHURCHES IN ONE CENTER
AFFILIATED WITH CHURCHES IN TWO CENTERS
AFFILIATED WITH CHURCHES IN THE COUNTRY OR OUTSIDE COUNTY

FIG. 6.—VILLAGE- OR CITY-CHURCH COMMUNITIES
Although many churches of the county are in the open country, a significant percentage of farm homes is affiliated with the village or city churches, forming real church communities. The township lines are shown.

There are a few abandoned open country churches along the roadsides; but the neighborhood country churches are usually in more or less active operation. In some of the religious bodies it is the prevailing practice for the village minister to serve also one or two open-country charges, a custom which forms one more link between village and country in the same general trade zone.

At certain of the incomplete civic centers, with small population and only partial trading facilities, there is a single church, usually of some one denomination, but generally considered as a "community church". A resident minister is in charge, and a vigorous social life is in progress. The favoring circumstance for this aggressive activity

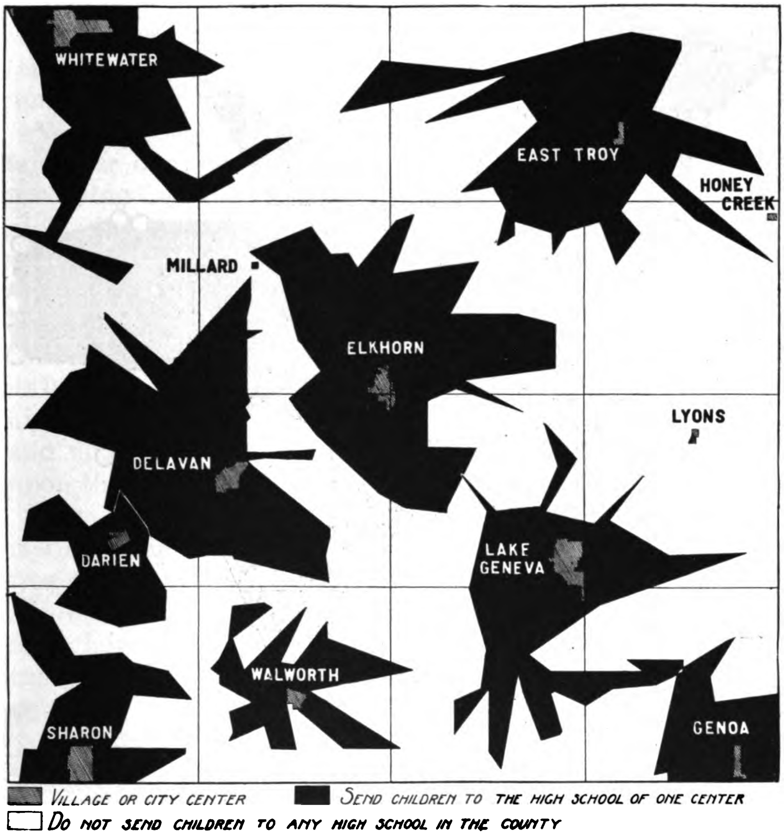


FIG. 7.—HIGH SCHOOL COMMUNITIES IN WALWORTH COUNTY, WISCONSIN

Notice the fact that the trade-center high school is used by farmer and villager alike; that there are wide farm-land areas making no use of the high school. Compare with township areas.

seems to be the blend of farm and hamlet cooperation in a single church parish.

It should be remembered that no attempt was made in this survey to study church groups as religious bodies, and farm-home connections with the open country churches were not considered.

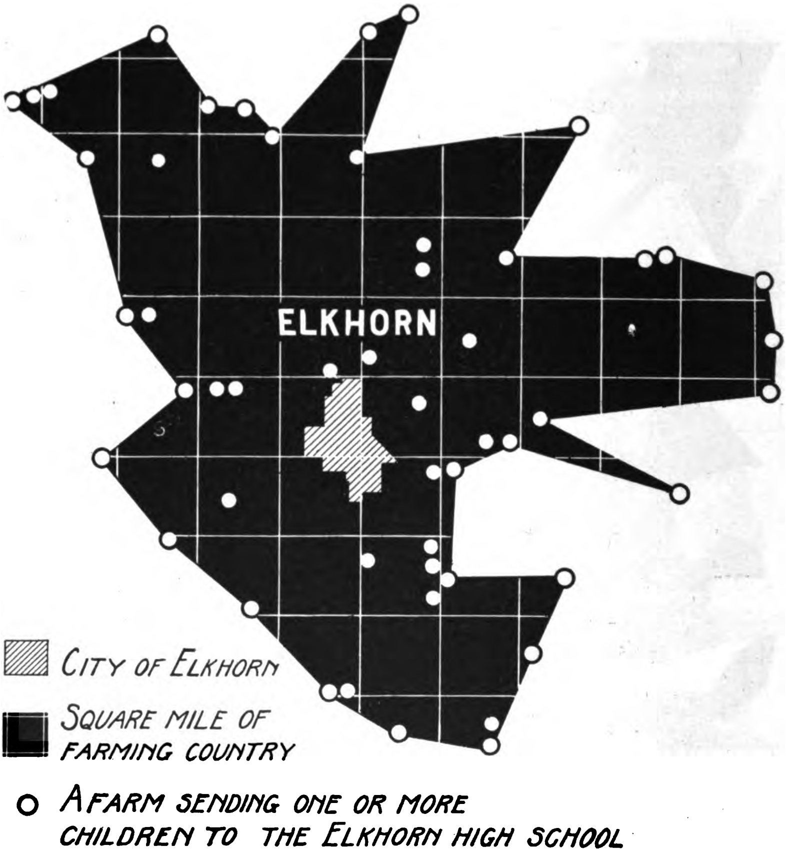

ELKHORN
▨ CITY OF ELKHORN
■ SQUARE MILE OF FARMING COUNTRY
○ A FARM SENDING ONE OR MORE CHILDREN TO THE ELKHORN HIGH SCHOOL

FIG. 8.—THE HIGH SCHOOL COMMUNITY OF ELKHORN

This resembles in a general way the Elkhorn trade community, but three miles seems to be the present distance limit.

Nine high school zones.—With the exception of a few compactly grouped square miles in La Grange Township, and a scattered square mile here and there, no part of Walworth County is more than five miles distant from an existing high school. Practically every farm home in the county is easily within daily reach of some high school. Taking the county as a whole, less than fifteen per cent of the farm homes are sending children to high schools.

The high school zones are not only much smaller than the trade or banking zones, but the proportion of farm homes within the zones using the high school is much smaller than that using the shop or bank. It will be noticed that the form of this zone follows the general lines of the trade zone. Instead of an over-lapping of zone lines giving a belt of neutral territory, there appears surrounding every zone a belt of homes outside the influence of any high school.

With all the general deficiency apparent in the amount of farm use of these nine high schools, it is plain that a fair percentage of the farm families within two miles of each high school recognizes its value. The character of the high school as an agent in idea-forming and association-making, plays a wonderful part at the adolescent period of life, in democratizing the children of the farm who attend and the children of the village. It would be difficult to overestimate its influence as a force for constructive cooperation, were each high school consciously controlled in adaptation of subjects and management of courses in the interest of those living upon the land as well as of those living in the small city.

Four village library zones.—Four fine examples of the institutional library are in the county. The privilege of free use is open to farm families, and a certain considerable number of farm homes, in fact, thirty-one per cent of all farm homes within the library zones, avail themselves of this privilege. A wider farm use of the high school would doubtless lead to a wider use of the library.

The school districts.—A study of the country school districts of the county shows the fact that the prevailing scale of organized farm life is that of the neighborhood. The school house, an open country church, and a creamery, may frequently be found together, among fifteen to thirty families, in a territory of from three to five square miles. A slight tendency to consolidate adjoining school districts exists, but it is only slight. There seems to be a greater tendency to enlarge the village or city districts by addition of farms. It will be seen that Delavan has a school district of thirteen square miles; Lake Geneva, ten; East Troy, seven; Lyons, six; and Elkhorn, four. This probably gives Delavan one million dollars more of taxable farm property for the maintenance of its schools than Elkhorn has, while it gives to fifty farm families around Delavan the privilege of some control in their high school.

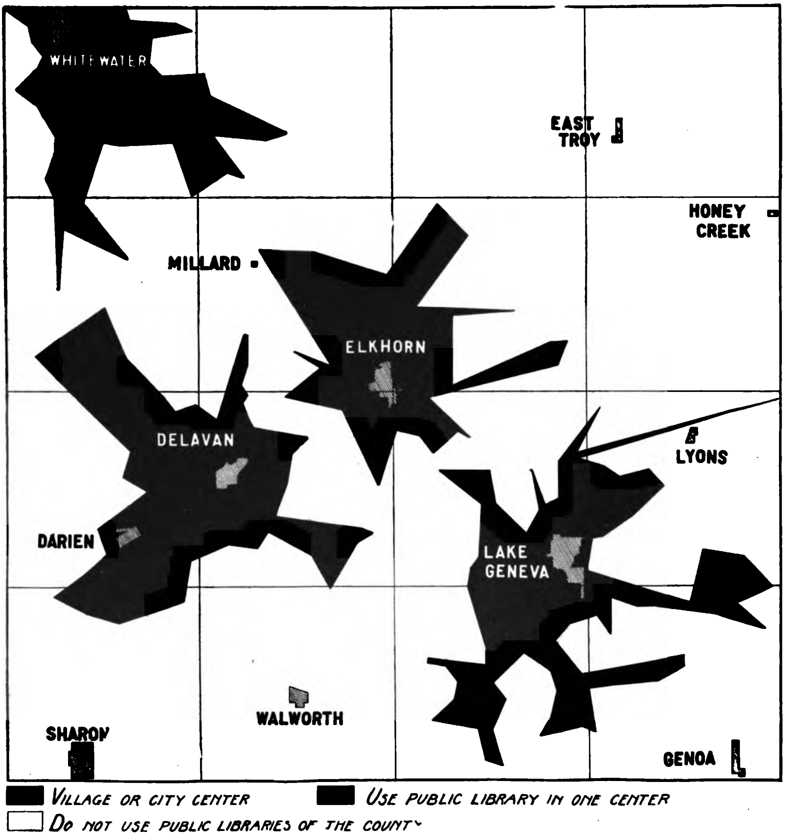


FIG. 9.—PUBLIC LIBRARY COMMUNITIES

Why should not the trade center library be as available for farm homes as the bank?

¶ *The actual but unofficial community.*—Eight of the twelve civic centers of Walworth County are incorporated; four as cities and four as villages. Officially, that is legally, the incorporated centers are treated as communities, each by and for itself. The foregoing analysis of the use of the leading institutions of each center by the farm population discloses the fact, however, that these institutions are agencies of social service over a comparatively determinable and fixed area of land surrounding each center; that this social service is precisely the same in character as is rendered to those people—whether artisans, employees, or professional

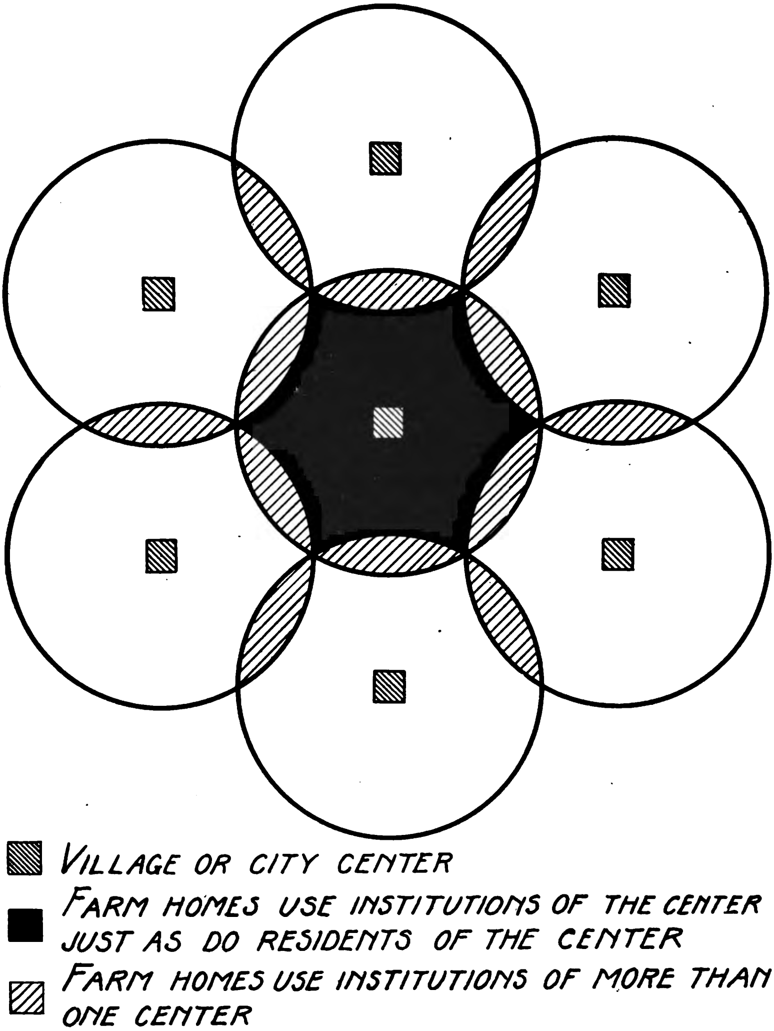

▧ VILLAGE OR CITY CENTER
■ FARM HOMES USE INSTITUTIONS OF THE CENTER JUST AS DO RESIDENTS OF THE CENTER
▨ FARM HOMES USE INSTITUTIONS OF MORE THAN ONE CENTER

FIG. 10.—THE THEORETICAL FORM OF AN AGRICULTURAL COMMUNITY

If all the conditions relating to farm homes and neighboring trade centers were conceived to be equal, then apparently the agricultural community would be in the form of a circle whose outer edge it would share more or less with neighboring communities.

persons—who happen to live within the corporate limits of the city or village; moreover, the plain inference is that the inhabitants of the center are more vitally concerned in reality with the development and upkeep of their particular farm land basis than with any other equal area of land in the state.

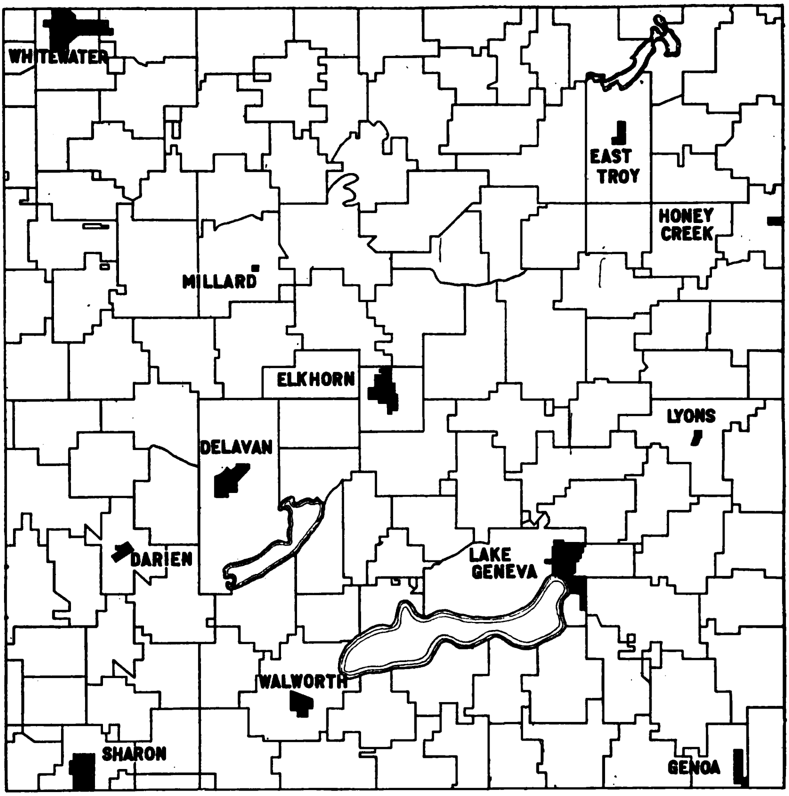


FIG. 11.—A MAP OF THE SCHOOL DISTRICTS OF WALWORTH COUNTY
The small zigzag areas on this map show the scale of the prevailing type of organized rural social life in Wisconsin. The village and city centers, however, suggest a changing scale commensurate with the coming economic rural order.

It is difficult, if not impossible, to avoid the conclusion that the trade zone about one of these rather complete agricultural civic centers forms the boundary of an actual, if not legal, community, within which the apparent entanglement of human life is resolved into a fairly unitary system of interrelatedness. The fundamental community is a composite of many expanding and contracting feature communities possessing the characteristic pulsating instability of all real life.

A conventionalized community form.—It is possible to conventionalize the form and relationships of these twelve actual agricultural communities in the following way. Suppose the civic centers to be equal in size and population, equally complete institutionally, and equally distant from each other; suppose all farm homes to be connected with the centers by equally good roads at all seasons of the year, and also equally direct. Then apparently each community would be a circle, with the agricultural city as its center, having a radius somewhat longer than half the distance between any two centers. In order to include all the farm territory within some circle, and to have the least possible common area, we must impose the further condition that the centers be arranged so that only six centers are equally distant from any one center, as shown in Figure 10.

PART II

THE AGRICULTURAL COMMUNITY

Existing Rural Conditions

Social handicaps of farm populations.—Certain disadvantages falling to the lot of farm populations, even in the oldest well-settled districts of the United States, have hindered the social development of the open country. The social problem of the farm home is perhaps largely one of finding ways and means of compensating for its social losses—whether natural and inevitable or more or less blindly accepted and patiently endured—by new gains that remain social in character. Hitherto country life compensations, many and obvious though they have been and important withal, have still been quite individual. This study is presented in the hope that a realignment of village and farm, of small city and the people on the adjoining land in accord with their actual underlying relationships will open new social resources to the farm home without detriment to the village or city and will go far toward offsetting the present social handicaps of country living.

Occupation.—"As an occupation farming has dealt largely, if not exclusively, with the growth and care of plant and animal life. Broadly speaking the farmer has been engaged in a struggle with nature to produce certain staple traditional raw foods and human comfort materials in bulk. He has been excused on the whole from the delicate situations arising from the demands of a manifold variety of human wishes, whims, and fashions, perhaps because the primary grains, fruits, vegetables, fibers, animals, and animal products have afforded small opportunity for manipulation to satisfy the varying forms of human taste and caprice. This exemption of the farmer and his family in the greater part of their activity from direct work with persons and from strenuous attempts to please them, will doubtless account very largely, perhaps more largely than mere isolation on the land, for the strong individualism of the country man.

"In striking contrast the villager and city worker have always been occupied in making things or parts of things out of such impressionable materials as iron, wood, clay, cloth, leather, gold, and the like, to fit, suit, and satisfy a various and increasingly complex set of human desires; or they have been dealing directly with a kaleidoscopic human mind, either in regard to things or in regard to the troubles and ideals of the mind itself. This constant contact with persons in business and professional life will account, even more fully than mere congestion of population, for the complex organization of city life. The city worker knows men, the farmer knows nature. Each has reward for his deeper knowledge and each suffers some penalty for his circle of ignorance.*"

Residence.—In southern Wisconsin there are five or six farm families per square mile as compared with one in northern Wisconsin. The detachment from the currents of human life resulting from this distance of a mile or two between neighbors, is not so disastrous on the whole in its depressing mental effects, as in limiting the acquaintance of each home, casual as well as intimate, to a small number of people living under similar conditions, especially that of occupation. The practical effect of this limited acquaintance is to invite the penalties of inbreeding—breeding together the same sort of partial experiences within a narrow domain. It has been noted* in a community study that farm homes situated on the main traveled roads between villages or cities are more socialized, having a greater number of connections with the organized currents of ideas, than farm homes on the back roads. Bare familiarity with other types of human life seen passing by the houses at close range apparently inoculates the home with some social adventure.

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*Galpin, C. J. Rural Social Centers in Wisconsin. Wis. Agr. Exp. Sta Bul. 234: 1-38.

The four–to eight–mile distance of a farm home from its nearest village or smaller city has been a severe check to diverse acquaintance and social connection at the village. The library, high school, and church zones around each village in Walworth County show how fortunate socially the farm home is which happens to be within hearing of the village church and school bells.

Institutions.—City populations and in a smaller degree village dwellers have created public institutions calculated to reinforce mightily the individual home in many aspects of family ambition. Accumulated acquaintance with human life in business and in concentrated personal contact has made this possible; but the farm worker has developed only a few institutions, quite simple in organization. The country family faces its problems almost alone. This single-handed struggle, while it has been reduced to a process of strong family selection, has resulted in an acute handicap.

Local government.—Village incorporation and city charters have enabled village and city populations to achieve wonderful results. Taxing power for enterprises in which the whole population is interested, a representative discussional and executive body, municipal ownership of visible property have created new paths to social progress. These devices of city government have been favored by two conditions: (1) the people are interlocked in a close system of common interests and (2) they are visualized, more or less, as a unit.

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*Galpin, C. J., Social Agencies in a Rural Community, First Wisconsin Country Life Conference Report, p. 17.

In utter contrast the outlying farm population has had an unwieldy township and county local government. Spread out widely, it was difficult for the imagination to unify the people concerned; but far worse, the township has been artificially made, enclosing areas of land along with the people on the land with almost as little regard to the trend of common interest and the social paths of the people, as the section lines enclosing exact square miles of territory.

The foregoing maps show conclusively that farm people on the land are situated on the slopes of social watersheds draining into one specific village or small city; that these social watersheds ignore township and county lines. No wonder it is difficult to get people who belong to different social basins, whose paths constantly lead over different roads toward different civic centers to work together aggressively under a township plan in regard to matters which belong naturally only to the homes that move together in the larger affairs of ordinary life. This maladjustment of local government is perhaps the fundamental handicap of the farm home.

The cumulative force of this series of social losses produces a rural social handicap great enough to challenge our national optimism.

The farmer a man without a legal community.—The farm home trades at a village, but shares the invisible government of a township. This scatters and mystifies the community sense of the farmer. He has no certain unambiguous rallying point. Community loyalty is atrophied. He responds to his neighborhood, to his state and nation; but he is as yet a man without a comprehensive community. This is a tremendous deficiency in the social history of the farm home.

Scale of organization in the neighborhood.—In general, with exceptions well worth studying, the social institutions of farm populations in Wisconsin, have been of neighborhood type and scale. The district school is a symbol as well as an example. From a dozen to thirty families combine. The creamery, mill, cross roads blacksmith shop or store, open-country church, and farmers' club are further examples. The church and factory may be of an inter-neighborhood type and scale. All of the inbred traits of neighborhood life persist in these close-set institutions. For the larger, more expensive types of organization there has not been sufficient rallying power, or social cohesion in large tracts of open country to produce the institution. The result is an outright concession by the farm home of certain institutions to village life, in a spirit of resignation. "They are not for us," "If we want them, we must go to the city." This small scale of organized social life, probably quite justified in the slow-moving, individualistic frontier age, is carried over with stubborn momentum into a period of rapid transportation, scorn of distances, and an increasingly large scale of farm business.

Evasion of institutional responsibility.—High school education for farm children in Wisconsin is not provided by farmers themselves, in school plants owned, supervised, and controlled in whole or in part by farmers; instead, with the exception of the cases of a few township and union free high schools, the farmer sends his children to the village-or city-owned high school and pays tuition. In this way, the farmers' child takes the sort of education he finds, and is placed under the influence of a set of circumstances and conditions with the creation and control of which the farm home has nothing to do. The farmer owns and controls his neighborhood school, under the advisement of the state, but he eludes the responsibility of high school ownership and control, by this indirect rental, which in Wisconsin the township pays for him, and he pays by tax to the township. The result is, of course, that as the high school maps of Walworth County show, the farmer is making small use of the high schools, and the high school idea, with all its power to reinforce individual life, is not made available on the whole to the farm home.

Surplus profits sent away from the land.—It is well known that new lands are developed on surplus capital from the older, well-settled districts. The West has been debtor to the East. The eastern farmer has loaned his surplus profit to the western pioneer at an alluring rate of interest. Moreover, the city industry both commercial and municipal, has made a bid for the farmer's surplus. A small city in Wisconsin with social boldness bonds itself for modern high school equipment, for municipal water plant or electric light plant. The bonds look good, and the farmer, living ten miles out, buys. City social-minded audacity creates these institutions for city man and village dweller, and the profits from the farm sometimes go into building this equipment. The city man pays his interest, and gains the tremendous social power of the institution. The farmer merely gets his interest. Between the allurements of fruit lands in distant states, high interest-bearing farm mortgages outside his community, and the safe bonds of municipalities, a certain per cent of the surplus profit made from the land is carried away, just as the land itself is eroded by the spring floods or sold off in the bushel measure. The plain assumption on everybody's part is that this is good business, and morally right, especially if the profits may not be efficiently used in a larger working capital on the farm, or for more of the human comforts in and around the home. All the while, it is overlooked in this procedure that the social reinforcement of a farm population, akin to the empowering of the city man, can come only through social institutions, owned, controlled, and adjusted, at least in part, by the people on the land for their benefit. This means that a certain percentage of the surplus profit of the land and of the labor income of the proprietors of the land must be set aside as a sinking fund for social institutions, else a false and depleting social procedure is being followed which will tend to impoverish the life of the people.

SOCIAL PRIVILEGES OF VILLAGE OR SMALL CITY

Corporate rights.—The general law has recognized the village as a community. The visible unity of the village group of houses, stores, and shops has been the main warrant for treating the village or small city as a community all by itself. The people are closely related in business and life and come to feel a real solidarity.

The legal provision for incorporation is a presentation of a set of new powers, and new duties to this group of homes as a comprehensive social unit. A village legislature, a village executive, the thinkers and actors who individually have succeeded by forecast, insight, integrity, and perseverance, are now banded for the village interests. The president or mayor now begins to have his vision widened from a community pedestal, and a new social machine for progress with power is put to work for the common good.

Manifold social agencies.—Organizations and institutions spring up instinctively for the village population. It is assumed that there is to be a church or churches. A village without this ancient public agency at once loses caste. The children of villagers of course must have this social privilege of instruction in race idealism. Fraternal orders are assumed. Lodges quickly spring up. Human fellowship must have its ritual and mysticism for the villager. The library is assumed. It may wait for a benefactor, but it is counted on. As soon as there is sufficient taxable property the most important and significant assumption is made—the village will have a high school. It is taken for granted that the children of the village, children whose roofs are near together, should have the privilege of four years' training in idea organization and world acquaintance. Amusement halls, parks, bands, orchestras, and baseball grounds are soon provided.

As the village, following its city ideal, moves on into small city government, multiform organized agencies and institutions, voluntary, commercial, or municipal in the plane of public health, education, business, information, soon follow.

Perplexing relations of village and farm.—The institutional reinforcement of the village, along with the growing consciousness of village unity clothes the villager with a secondary social personality. This is recognized, even though disparaged by the farmer. Prestige is the outcome. Superiority is inevitable; but here begin the troubles with a necessary farm population, which the banker, store keeper, and blacksmith know as the goose that lays the golden egg. The problem is one of pleasing the farmer and getting his trade, without building him and his mind, capacities, and wishes, into the community fabric. The farmer's money is good and necessary and must be obtained and his goodwill retained; but how to accomplish this object is a problem. Thorough-going incorporation of the farmer into the stream of village activities is frustrated by the fundamental conception of the self-sufficiency of the village. The farmer is presented outright with a few donations, as privileges in order to bind him. Toll, of course, is to be exacted by villagers somewhere. Craft sometimes takes the place of open dealing. The farmer does not share in the control and responsibility of certain things which he occasionally enjoys at the village as a spectator. The outlying farm population is seldom massed. Its members come to town by team or automobile or on foot or horseback, do their business without a resting place of their own, stand on other people's streets, in other people's shops, and over other people's counters. They go back after some hours of absence to their own lands, occupations, and homes. In the village they are aliens, but aliens with a possible title to be conciliated. The embarrassment is on both sides. The farmer pays in so much in trade he feels that he ought to have consideration; he pays so little directly toward the institutions that the village considers that his rights are not compelling. Puzzle, perplexity, and embarrassment, obscure the whole relationship and situation; and the universal process of legalized insulation of village and city away from the farm, which has grown up undisputed, with scarcely a hint of abnormality, is constantly shadowed by this overhanging cloud of doubt.

READJUSTMENT OF RURAL POPULATIONS INTO COMMUNITIES

The land basis of a small agricultural city.—A study of the English village of the Middle Ages will throw some light on the modern American village and small city. Country life in England was village life. Farm houses were gathered into villages ranging from fifty to a thousand people. Around each village were the plow lands, meadows, pastures, and woods, spreading open, houseless, and barnless, to the similar zone of open fields belonging to the people of the next village.

The inhabitants of the small thatched houses of the village surrounding the great manor house of the lord, were largely farmers, both owners and tenants, and workers of various grades and classes, whose daily duties led them out to the fields and flocks and herds. Besides the farmers, were blacksmith, miller, court officer, baker, brewer, priest, weaver, and a few craftsmen of other kinds, dependent upon opportunity for work. The two great social institutions were the parish church and the manorial court. The interests were confessedly agricultural. The villagers not land-workers milled, baked, or prayed for the land workers, upon whom they depended, and they all lived together in one social mesh intricately interlocked.

The modern village and the modern city.—The modern village differs from the modern city mainly in this—the village industries are related directly to the needs of the outlying population on the land in addition to the needs of the village population. The city contains industries related to people scattered over the territory of county, state, or nation. As soon as a village obtains one knitting mill, or a latch factory, or plow works, or iron smelter and the like, whose products go to people who are not otherwise interested in the village, it begins to possess the problems of a city. As this process continues, it becomes less and less dependent upon the agricultural population within its immediate farm trade zone, and more and more upon scattered peoples of various sorts, who may never see the city. As the small city grows, outstripping its adjoining villages, these villages become more or less consciously satellites of the city. Wholesale needs are met in this city for village merchants, and special retail customers come to buy clothing and furniture from larger stocks. A trade clientele is formed reaching out over a county, or two, or three, of these seasonal or occasional village and farm buyers. This smaller city, then, has a significance for several communities, and becomes an inter-community center. Beyond this is the state center for trade—the metropolis like Milwaukee, with national importance.

Mutual interests of small city and farms.—So long as a small city is agricultural in its clientele, the land allied to it is a permanent social factor from generation to generation. It is a part of the equipment of the perennial elemental industry of this city or village. Were there a knitting mill on the edge of a small city, with five hundred employees living about the mill, this whole industry—land, buildings, and people—would be unquestionably part and parcel of the city. In like manner surrounding the agricultural city is a huge continuous nature industry, not directly unified to be sure, but real and actually united just the same. Surrounding Delavan, for example, is 100 square miles of land in its trade zone. This implies that Delavan is the center of an industry with a capital of $3,000,000 and 1,000 operators engaged in producing milk and meat for the nation. This is Delavan's industry in the same sense as the Bradley Knitting Mill is, and the homes of the 1,000 farm operators are related to Delavan in the same fundamental way as the homes of the mill operators.

Every inch of advance on the farm in intelligent skill, managerial ability, moral control, governmental development, will be reflected in the little city by an increased farm consumption of goods, higher grades of farm desire, and better qualities of farm citizenship; whereas the same qualities of skill, intelligence, and integrity in the city will be quickly transmitted to the farm and to the advantage of the population on the land, if avenues of social intercourse between "wheel and hub" are open wide.

Our study shows that the farm homes in the trade zone of a small city share with the city homes the major commercial and social interests requiring combined capital of many to carry on. Circumstances hitherto have hindered the large-scale development of some of these enterprises among the farm homes, but these circumstances may not be—in fact need not be—permanent; for the same incentive which has led the city population to spend some of its surplus profits upon equipment for religion, higher education, government, information, art, leisure, and play, is present in a latent form in the farm population, simply ready to be induced to join hands in an alliance of fair play.

STEPS IN REPLANNING A COMPREHENSIVE COMMUNITY

Map the community.—Recognition of the community nature of the city and the trading farm area surrounding it can begin without legal enactment or any change in institutional control. Such general recognition is the first step, on the part of both city and farm. Delineation of the territory included can be made, and maps of the area may become common and familiar objects of perusal. Some form of apt naming will help along the conception. The little city of Stanley, Wisconsin, has popularized the unity of its land basis by the constantly used phrase "The Stanley Country". The large American city has gained the enthusiasm of added bigness by linking to itself the adjacent municipalities whose currents of life and work empty immediately into it with such titles as "Greater New York" and "Greater Boston". The very conception of treating the adjacent land area as a mighty attached industrial part of the small city will give a dynamic point of view to all concerned.

Reconsider the organization and control of voluntary social enterprises.—The new community point of view will at once raise questions about the adequacy of all present social enterprises not under the control of governmental statute and ordinance. It remains for some socially awake community with this wide vision to grapple with the problem of an adequate readjustment of its social life so as to open channels of significant human contact to every home. No one can safely forecast the forms that will follow.

On the occupational side certainly a more intelligent appreciation and recognition of agriculture will prevail in the city, and a far keener sense of the processes of manufacture and merchandizing will permeate the farms.

Perhaps the church is the best example of an organized voluntary agency which will have to face the new community alignment. Setting new outer limits to the community first of all enlarges the responsibility of religious leaders for two things: one is an equal opportunity for every person within the limits for religious nurture; the other is that the form of organization shall be on a scale inclusive enough to preserve the new idea of democracy of land and street, and yet modeled after a type which shall provide for local needs everywhere. Possibly some form of central organization with branch Sunday schools and social center equipment will suffice. Possibly a close federation of already existing organizations on a more mutual basis will do. Surely American ingenuity is able to cope with this problem of community religion and recreation and manifold associated relations in the spirit of fair play to all those involved.

Begin discussion of a suitable form of community government.—Local government will be the last agency to recognize the agricultural community. The present political units, however maladjusted they may be shown to be, are tenacious facts; but discussion will open the way to safe reform. Already county government is under suspicion in many quarters. The friction between city and county jurisdictions where large cities are concerned is notorious. Many of the present county officers are acting practically for the state, while townships are attempting functions which properly belong only to communities. Economy, the prevention of jurisdictional friction and the maintenance of live governmental citizenship, requires that the small political unit shall coincide so far as possible with the social unit.

The Wisconsin school law is already available for bringing the high schools of a county under the ownership and control of communities. It may be found that other legal instruments are ready in hand to begin carrying into full effect the agricultural community idea.

EVIDENCES OF ALLIANCE BETWEEN TOWN AND FARM

Commercial clubs turning to farm advancement.—A partial recognition of the interrelated character of farm and business progress is seen in the recent discussions of small-city clubs. There is a momentary respite in the discussion of how to subsidize another industry and lure it into the city. The topic rather is how to establish a market in the city for the farm producer and city consumer; how to provide rest rooms for farmer and wife when they come to town; how stable more comfortably and sanitarily his team; how drain the farm lands adjacent to the city and open a way to a larger working and consuming population; how to put up grain elevators, milk condenseries, cattle yards, correctly and adequately; how to change the type of farming in the interest of larger production so as to insure permanency in land values; how to encourage and facilitate the purchase of more cows, by providing new means of credit; how to instigate business methods on the farm, so successful in city enterprise. Not merely discussional, but actional, has this attitude been. City clubs have dined their farmer neighbors and planned with them for these bigger land improvements, and have invested thousands of dollars in concrete enterprises.

Interest of banks in agriculture.—The banker is father confessor to the farmer. The village banker is nearly as far-reaching now as the merchant. The recent aggressive interest of bankers' associations in corn production, in pure-bred seed, type of farming, and soil conservation is an indication of the awakening of the village and city to its local land basis. The initiative already produced in the farmer by this city sympathetic action is one of the best indices of what would continually take place in a community by an out and out consolidation of village and country community major interests.

Concentration of milk industry in villages.—The rather rapid rise of the milk condensery in the smaller cities and large villages, combining facilities for shipping cream or milk, and condensing the surplus into small cans or for metropolitan use in ten-gallon lots, shows the changing order of the milk industry. In place of the neighborhood factory, there is coming large-scale organization: the neighborhood factory may become an auxiliary station for the condensery and large factory. The social center of the land area is drawing the milk for large-scale manipulation.

Growth of union free high schools in Wisconsin.—The movement toward a rural high school is exceedingly instructive as a groping after a need. The township high school was a splendid start and recognition. All the land and property of the township should be taxable. Farmer and villager should share in the ownership and control of the school. The school should be located centrally in the township for all.

As it works out, if there is a township with a village near the center, so that practically every farmer in the township is in the trade basin of this village, then no insuperable obstacles are present. But not many townships are so favorably constituted. The result is that only a few townships have adopted the township high school plan. When it came to a vote in many places, it was found that the township was too artificially bounded. So the union free high school plan was adopted as an improvement in the flexibility of lines. Any thirty-six square miles of contiguous territory running along section lines, might by vote constitute a district for the operation of a high school. In practice this enables a village to cooperate more completely with its socially allied farm homes. A union free high school with a district running here and there, to take in the farm families that go to the village for trade, is quite exactly an alliance of farm and village along the lines of actual relationship.

Forming town and country clubs.—No indication of rural progress is more signal than the town and country club movement in villages and cities. The automobile has opened to the city home the frequent use of country highways. This has led to other open air discoveries and enjoyments. The town and country club is based on business methods in connection with land projects.

Modernizing farm homes.—It has been assumed by many people that the farmer's standard of living is basally, unchangeably different from that of the village dweller—so different that one could never expect a happy social mingling of country people and village people. The modernized farm houses, equipped with running water—hot and cold—electric or gas lights, gas stoves, bath-rooms, sewage disposal plants, furnace heat, are becoming more frequent. The difference between rural standards and small-city standards where there has been for the rural home some social opportunity, some education, some contact with world currents, is no greater than the difference between standards of living within the same large village or small city among classes that use the same schools and churches, and coöperate in all the major enterprises of life, even though they may not fraternize together in circles of family intimacy. The rapid transformation of the country youth in clothes, manner, diction, and muscle action in the atmosphere of the city is a further indication that the so-called "rural mind" is amenable to a changing social order.

THE "RURBAN" PROBLEM

Ruralism and farm segregation.—The prevailing school of thinking on the rural problem, commonly expressed in recent books, magazines, newspapers, and the agricultural press, sounds the slogan "Keep the boy on the farm". There goes with this cry the demand that the farm home shall be "brighter", country schools shall be "redirected toward the land", business shall be "cooperative", religion shall be "social". This program of pure ruralism may be reduced to segregation of the farm population—keep the farmer a country man; erect his schools in cornfields; build his churches in the far open; create an agricultural class consciousness; and restrict farm business largely to cooperation of farmers.

"Rurbanism" a new application of democracy.—A view of the rural problem as one more problem of democracy has led to this study of the underlying relationship of the civic cluster and its land basis, of the shop population and the surrounding trading farm population. Study is gradually disclosing such a mesh of interrelated social interests uniting small-city dweller and farmer that no doctrine seems adequate to the rural situation which does not frankly recognize both factors. The rural problem is a part of the "rurban" problem, and "rurbanism" as a school of thought first of all points to the actual social partnership of farm and village or small city, and then raises the question whether segregation of the farmer is desirable or even possible.

The writer was visiting a few months ago a new $35,000 consolidated school "in a cornfield". The project was superb and seemed to realize the highest expectations of everybody in the state. The splendid opportunity for every country child within five miles was an ineffaceable impression. As the writer full of enthusiasm was waiting for the train he remarked to the president of the school board, "What brick building is that going up over there?" "Oh, that is a new store", was the reply.

"Why, what is that other new building, I see beyond the trees?" the writer asked, as he began for the first time to scrutinize the vicinity of the school.

"That, oh yes, that is a new church," the president said.

"And here is a grain elevator, I see," the writer said; and then with a dawning idea, he added, "I'll tell you Mr. H————, what you are going to do. You are going to come here and build a house and bring your family, so as to be near this wonderful school."

"Do you know," he then admitted, "I have thought of just that."

"And then you or somebody else will buy up and plot this land and others will come and you will have a little city on your hands with a 'rurban' problem," the writer thought in his own mind.

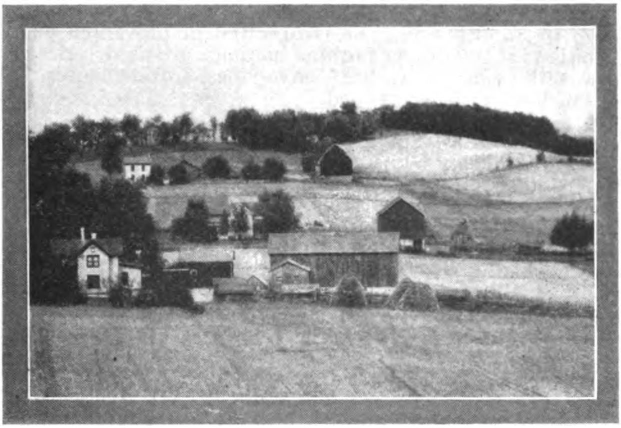
The creation of magnificent, large-scale farm social institutions in the open will simply create new magnetic centers; and if these new centers are accessible and comprehensive, people will be diverted from accustomed paths and settle about them, and villages will be started and the making of a city will begin. The primitive antagonisms between buyer and seller, employer and employee and borrower and lender, are being slowly mitigated through enlightenment by readjustment to the facts. The ancient antagonisms between countryman and city dweller under the dynamics of a new democracy, may possibly in like manner be transformed into community alliances. A community platform may possibly be erected so high that the mutual interests of the land basis and the civic cluster shall ever be in plain view. It is quite certain that the successful modern farmer, whose business methods have become social, whose products, such as fruit, live stock and milk, reflect in their quality wide and exacting social demands, who has full scope for scientific methods and intellectual satisfaction, cannot be segregated away from business centers. The main question is whether the farmer shall be willing to enlarge his social responsibility beyond the small rural neighborhood and accept the large-scale responsibility of a comprehensive community. Socially he is now a free lance. His automobile takes him quickly beyond the bounds of his little kingdom. "Rurbanism" would ask the farmer to assume his full share of responsibility in community alliance, both social and governmental, from which he would gain the removal of his present social handicaps and maladjustments without loss of his native independence.

PROPERTY OF DIVISION OF
FORESTRY
COLLEGE OF AGRICULTURE
UNIVERSITY OF CALIFORNIA

Bulletin 272 **August, 1916**

Keep Our Hillsides from Washing

A. R. WHITSON AND T. J. DUNNEWALD



STOP GULLIES BEFORE THEY START

Erosion must be prevented or the beauty and fertility of our hill-side farms will be ruined.

AGRICULTURAL EXPERIMENT STATION
OF THE UNIVERSITY OF WISCONSIN

MADISON, WISCONSIN

DIGEST

Erosion or washing can be controlled or prevented on thousands of acres of land if the proper farming methods are used. Besides cutting the farm with gullies, "washes" or ravines, erosion causes the washing away of much valuable plant food. Pages 3–5

The amount of land injured by erosion varies in different sections of the state. Probably 50 per cent of the farms in Wisconsin are subject to erosion of some importance. In southwestern Wisconsin erosion occurs on at least 75 per cent of the farms. Pages 5–7.

Erosion depends on four things—the distribution, of the rainfall, the character of the soil, the slope and the vegetation. Pages 7–9.

Erosion can be prevented in many instances by careful tillage, by alternating crops on side hills, by the use of horizontal channels and terraces and by protecting the ravines and water courses. Pages 10–14.

Ravines and water courses can be protected by stones which, to a large extent, prevent the removal of the soil, or by grass the roots of which hold the soil. Pages 14–17.

On wooded hillsides remove the trees gradually if there is danger of erosion. If the trees are all removed at once, "washes" and gullies are formed before the grass has time to get started. Pages 17–18.

Side hill land should be used for pasture. If it is necessary to grow a crop, oats and peas, alfalfa, sweet clover, or brome grass make good substitutes for crops which require cultivation. Page 18.

Keep Our Hillsides from Washing

Wisconsin has hundreds of thousands of acres of rolling land which if properly managed can be successfully farmed, but which if carelessly handled will be greatly injured by erosion or side-hill washing.

This injury is partly caused by loss of fertility and partly by the development of gullies and ravines which cut the fields so they cannot be cultivated.

Loss of fertility.—The losses of fertility caused by erosion are due to the removal of the organic matter and fine silt of the soil. The organic matter is not only rich in the essential elements of plant food itself, but its decomposition causes important chemical changes in the remainder of the soil. The finer earthy matter of the soil is not only relatively richer in the plant food elements than the coarser particles, but also has a larger water-holding capacity.

The result of the removal of the organic matter and the finer silt and clay is that soils which have been washed, lose a considerable part of their nitrogen and phosphorus and have a lower water-holding capacity. When not very carefully managed in regard to the application of manure and rotation of crops, these soils show shorter life and are more subject to drought than soils on level land.

As an illustration of the effects of erosion, an instance met in Eau Claire county may be cited. A small pot hole without outlet and surrounded by sandy loam soil received the sediment washed down from the surrounding land, but, due to the coarse texture of the subsoil, underdrainage permitted the escape of water so that only the sediment collected. An analysis of this sediment and of the soil of the side hills from which it had been washed, showed that it contained nearly three times as large a percentage of nitrogen and more than twice as much phosphorus as did the soil from which it had been removed.

In another instance, where determinations were made on a moderate slope from which much of the surface soil had been removed and of the soil which had collected at the bottom of the hill, the analyses showed the following amounts of nitrogen and phosphorus.

	Nitrogen	Phosphorus
Hillside	.340 Per cent	.085 Per cent
Bottom land	.450	.140

This data shows that the soil removed by erosion is the richest part of the land. Especially is this true in regard to the element phosphorus.

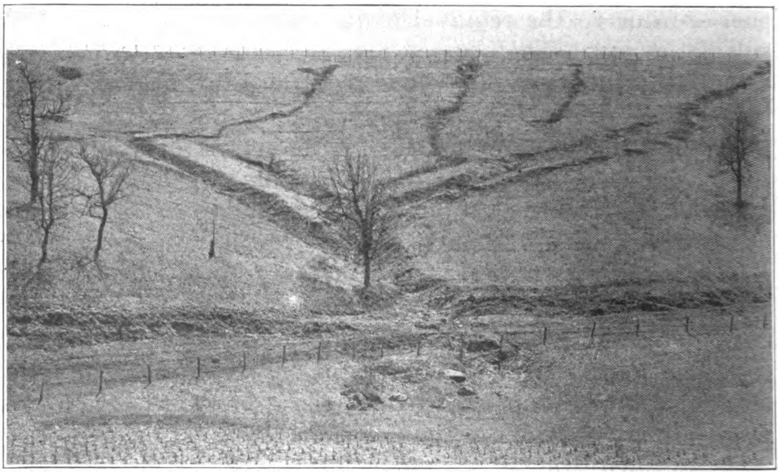


FIG. 1.—ABANDONED BECAUSE OF SEVERE EROSION

This sloping land was once under cultivation. The present ditches could have been avoided by running a shallow ditch parallel with the fence at the edge of the cultivated field near the top of the hill. Such a ditch could have been made to carry off the surface water toward the right at a low angle. This field has a 15 per cent slope which is about the upper limit for cultivation.

It is usually supposed that injury of this kind is limited to rather steep slopes, but careful observation during and immediately after rain storms will convince any one that erosion and removal of the finer sediment actually takes place on slopes having a very slight gradient or fall. Slopes of one and two per cent are subject to some erosion and when the slope reaches three or four per cent the erosion, so far as the removal of the most fertile soil is concerned, may become considerable.

Gullies develop easily on some soils.—The most obvious, but not the most serious injury produced by erosion, is that of the development of gullies and ravines. These are caused by the concentration of streams on side hills, especially after the removal of some protecting feature such as forest growth, or the breaking of the sod when the land is brought under cultivation. On some types of soils, these gullies are very much more apt to develop than on others. These gullies not only destroy valuable land, but cut the fields so they cannot be worked to advantage. An illustration of the effect of the development of gullies is seen in Fig. 1. A little care and effort at the right time would have saved this field.

EXTENT OF EROSION

It is, of course, difficult to measure with any degree of accuracy the amount of land in the state injured by erosion. An effort to estimate this on the basis of studies in connection with the Soil Survey has been made. The land influenced by erosion has been divided into two classes; first, land which is capable of cultivation, but is so steep that the amount of erosion makes it impracticable to use the ground for tilled crops, such as corn or potatoes more than one year in a rotation of from four to six years. These fields should be in grass or hay the greater part of the time. The second class includes land which is subject to an important amount of erosion, though with proper care the damage is not sufficient to prevent the ground being laid out in shorter rotations—from three to four years, which may include such common rotations as that of corn, oats, and clover. In the southwestern portion of state, covering nearly a third of the area of the state, the first class amounts to 20 per cent of the tillable land and the second class to 40 per cent.

In the remainder of the state which was glaciated and as a whole is not so rough in topography, the land in the first class amounts to about 12 per cent and that in the second class to about 25 per cent of the tillable land. If the estimate is made on the basis of the number of farms on which more

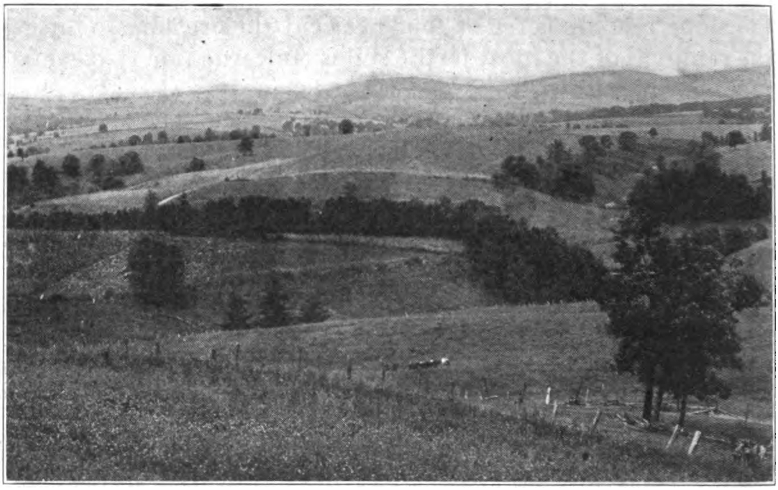


FIG. 2.—VIEW IN WESTERN OR SOUTHWESTERN WISCONSIN

The soil is excellent and with proper care its value can be maintained and increased, but if erosion is allowed to cut it up it may be largely ruined.

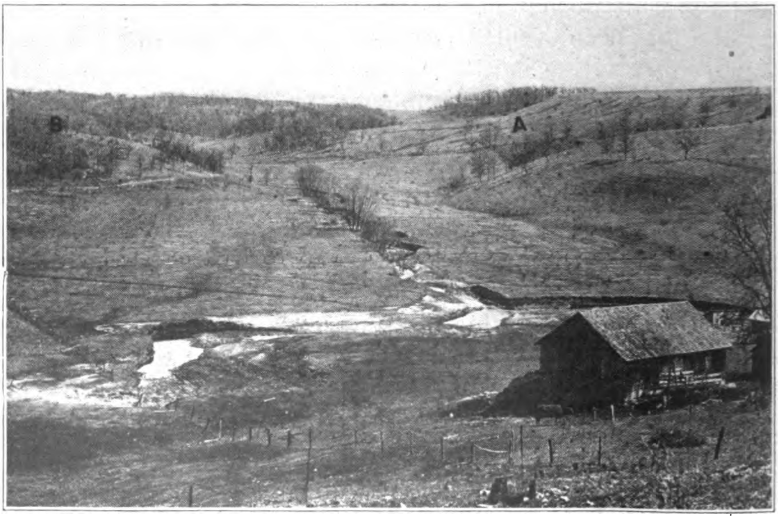


FIG. 3.—NEAR THE HEAD OF THE VALLEY

The eroded and timbered slopes and the outwash soil of the valley bottom are shown. In the foreground is an eroded slope, too steep and full of limestone fragments for cultivation, which is used for a pasture.

or less erosion occurs, the percentage, of course, in each case would be much larger. It is probably reasonable to say that in the southwestern portion of the state more or less erosion occurs on at least 75 per cent of the farms, while in the remainder of the state probably 50 per cent of the farms are subject to erosion of some importance. Considered in this way it is evident that erosion is one of the most widespread sources of injury to soils and therefore one in which a very large number of farmers are undoubtedly interested. (See Figs. 2 and 3)

Above the second barn A at the right in Figure 3 is an eroded field, once cultivated which now has many bad gullies, because it has been unprotected from the surface flow of the ridge land above. There is too much of this steep and stony slope land in the driftless area which is making but a very small contribution to the income of the farmer. The valleys are so numerous that nearly every farm includes anywhere from five to forty or more acres of this steep land on which the erosion problem should be worked out. The side of the valley at the left B which faces northeast is still timbered and serves as wood lot and pasture.

CONDITIONS AFFECTING EROSION

There are several factors which affect the amount of erosion and the injury it produces. Among the most important are the distribution and amount of rainfall, the character of the soil, the slope, and the condition of vegetation.

Rainfall.—Rain falling slowly may be entirely absorbed by the soil and percolate or soak through it so that none runs over the surface to cause erosion.. When the rainfall is so heavy that this is not possible, surface washing begins. The heavier rainfalls which occur in the south, therefore, produce far greater damage than usually occurs in the north. A single storm with two to three inches of rainfall in the course of a few hours may cause more damage than several times this amount of rainfall distributed so that a larger portion can be absorbed by the soil.

Character of the soil.—It must be remembered that the flow of water over the surface takes place only when it cannot be absorbed by the soil with sufficient rapidity. Soils of a coarse texture such as sands and sandy loams are able to absorb water very much more rapidly than heavier soils and are therefore much less subject to erosion. (Fig. 4). On account of the fact that they are very largely composed of silt or soil grains of an intermediate texture, heavy soils are much more seriously affected by erosion than light soils as a rule.

The loessial soils, which are silt loam soils deposited by the wind and occur over a considerable part of the Mississippi Valley, including much of southwestern Wisconsin, are subject to this difficulty. They are especially characterized by their ability to retain perpendicular walls, which leads to the development of very sharp angular ravines and gullies which are especially difficult to control.

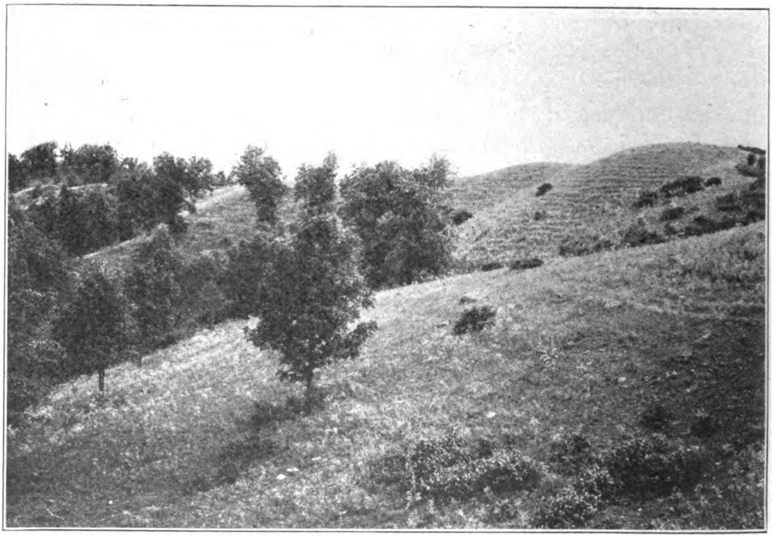


FIG. 4.—GRAVEL KNOLLS NOT EASILY ERODED

These gravel knolls, which are subject to considerable drought, are found in some parts of northern, eastern, and southeastern Wisconsin, especially in the morainic belts. Where they are covered by a heavier type of soil considerable erosion takes place.

Slope.—The degree of slope determines the velocity which water will acquire and its power to erode. Comparatively slight increases in the velocity give the water greatly increased eroding capacity. A stream running at the rate of two miles an hour can carry sixty-four times as much material as one moving at the rate of one mile an hour.

Vegetation.—Nature's method of controlling erosion is chiefly through the protection of vegetation. In the case of tree or forest growth, the roots of the trees tend to prevent the development of little gullies and ravines, and undergrowth increases the power of the surface to absorb water so that it is held during a heavy rain and permitted to soak into the soil gradually rather than wash down over the surface. The extremely fine roots of grasses have the effect of binding the soil together so as to even more completely protect it from the eroding affect of heavy rains. This is especially true of certain grasses, the root systems of which are masses of felt like fibers.

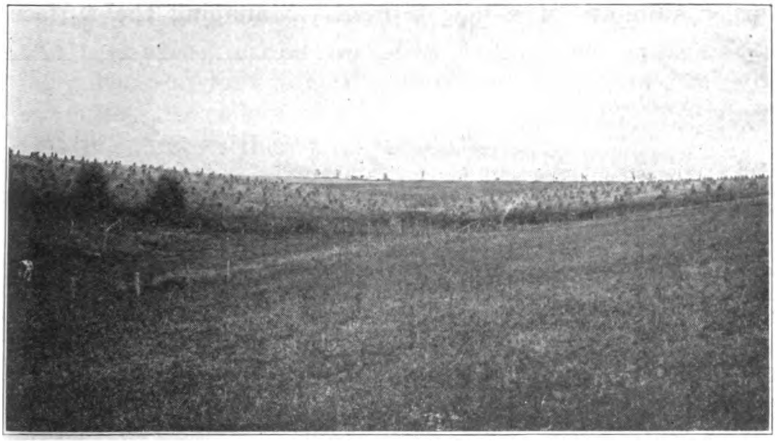


FIG. 5.—SODDED TO PREVENT WASHING

This picture gives an idea of size of the collecting basins or drainage area from which the surface flood water is often concentrated. In this case, it is the shallow depression at the left. This depression or draw is never cultivated and is kept in permanent pasture sod. Cultivation of the draw or establishing a lane or driveway down it would quickly cause ditches to develop.

The explanation of the effect of a grass sod, especially of blue grass, will be quite evident to one who will take the pains to cut out a block of the sod and attempt to wash the soil out of it. The difficulty with which the soil can be removed as well as the fineness of the roots will astonish any one who has not previously made observations of this kind. The effect of grass in preventing erosion is shown in Figure 5.

PREVENTION OF EROSION

There are several ways in which the tendency of soils to wash or erode can be lessened or largely prevented. Anything which can be done to increase the absorbing power of the soil so as to permit it to take in large quantities of water which will find its way down through the soil itself will, of course, lessen the amount which will flow over the surface. The removal of excess water in the subsoil by drainage will have the same effect, since it will permit the soil to absorb larger amounts of a new rainfall. Managing the surface of side hills so as to cause the water to take its way downward, when it must run on the surface, through channels of the least possible gradient or fall is a third method. Planning a system of farming for land having considerable slope to include as much hay and pasture land as possible is a fourth available method.

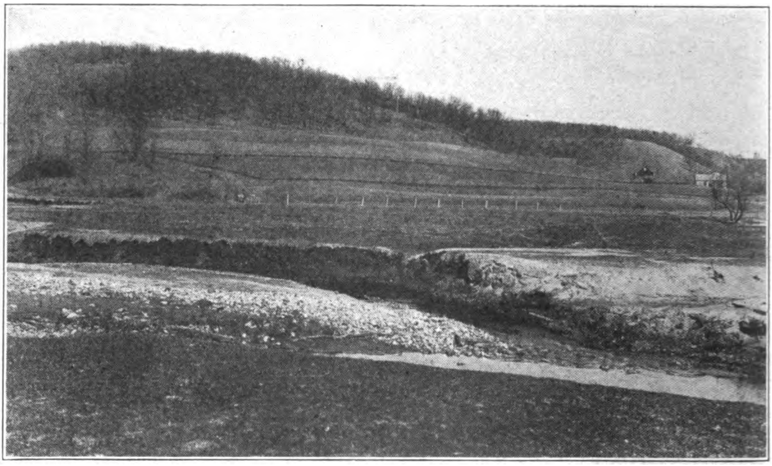


FIG. 6.—PROPER CULTIVATION OF HILLSIDE LAND

This farmer is plowing with the curve of the hill and turning his furrow up hill on the steeper part of the field. The timber left on the steepest upper slope compels the flood water to enter the soil instead of collecting in riverlets to flow over the surface.

The plowing of side hills as deeply as practicable and along the contour lines as shown in Figure 6 has the effect of increasing the amount of water which can be absorbed. This is particularly true if a reversible or side hill plow is used and always in such a way as to throw the furrow slice up hill. This has two beneficial effects, (1) to return the soil to a certain extent as removed, and (2) on account of the position of the furrow slice to permit a larger amount of the water to find its way into the soil than is the case when the furrow slice is turned down hill.

Tillage.—In cultivating corn which is check-rowed, it is important that the last cultivation before it is to be left for a few days be along the side of the hill rather than up and down. But it is also important to take care that any small ditches into which the water from the cross-rows runs are protected by grass or by sowing in some oats or they will be enlarged by the water coming in from these cross-rows.

Alternating crops on side hills.—One of the chief difficulties on long slopes is that of the tendency of little streamlets to collect into larger and larger streams which greatly increases their eroding power. This difficulty can be to a considerable extent overcome by laying out the fields in long and comparatively narrow strips on the side hills so that the land which is in tilled crops such as corn or potatoes will alternate with land in grain and hay, thus greatly shortening the distance down hill through which this accumulation of streams may take place. The sodded strips serve to check the flow of surface water, absorbing it and carrying it off beneath the surface. The proper arrangement of fields on hillsides is illustrated in Figure 7.

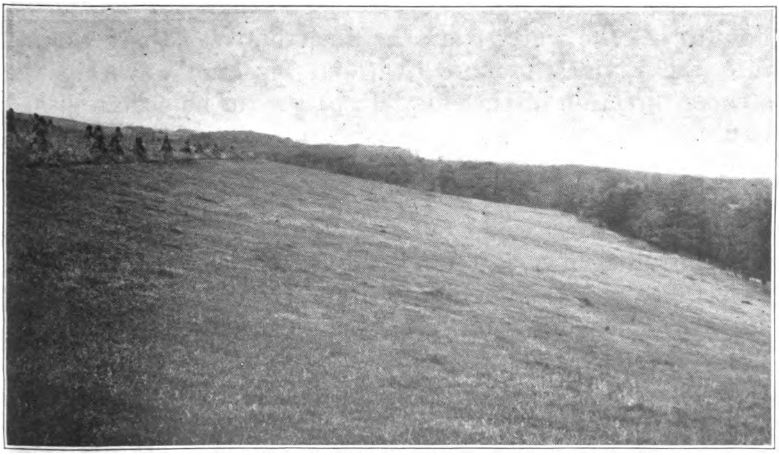


FIG. 7.—METHOD OF ARRANGING FIELDS ON A STEEP SLOPE

The cultivated and uncultivated crops are arranged in alternate strips across the slope, all cultivation being at right angles to the natural surface flow of the water. The grass strip appears wider than it actually is, due to the position of the camera. Timber still covers the steepest slopes below the field.

Use of horizontal channels and terraces.—When the slope of the side hill is considerable and the land is to be used for tilled crops, resort may be had to special methods for reducing erosion. These consist primarily in reducing the gradient or slope over which the water moves to lower levels, and secondly in having those channels which must have considerable slope thoroughly protected from erosion. On practically all hillsides there are already well developed ravines which if kept thoroughly sodded offer water courses which will not be subject to erosion. The problem then is how to get the water from the areas between these ravines into the ravines prepared without washing down in the steeper direction of the side hill. This can be accomplished in different ways dependent on the difficulty of the situation.

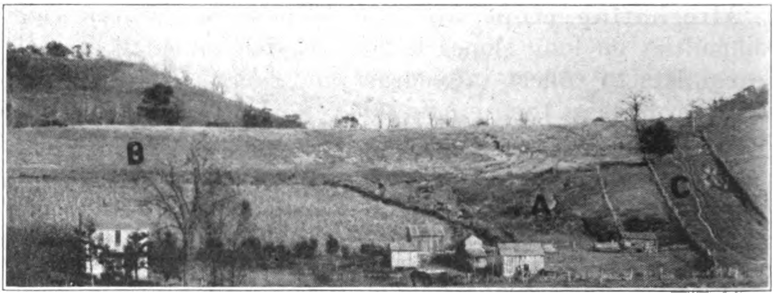


FIG. 8.—LANES OFTEN CAUSE EROSION

The danger of erosion is invited by having a lane or cultivated field run with the slope instead of across it. The steep land A could have been protected by a shallow sodded ditch above it running at a small gradient. The land C is developing bad ditches caused by the paths made up the slope. At B is represented land too steep to cultivate.

When the slope is not too great laying out the fields in long narrow lands which are plowed in such a way that the dead furrow has a slight fall and discharges at each end into the grassed ravines, is a practicable method. When the slope is too great for this method to be effective, more care must be taken and some form of terrace must be developed. It is necessary to lay out the lands or fields so that they will be plowed along the lines which are nearly level running around the side hill, that is, having just enough slope so the water will run slowly and not erode. To determine the location of these lines some leveling must be done. This, however, is comparatively simple.

The level is set up and adjusted at the top of the hill and the target rod held beside the instrument and the target adjusted three feet above the "line of sight." One person then carries this target along the side hill under the direction of the level-man who sights the instrument, giving directions for the placing of stakes from point to point along the line so as to make the contour line. These stakes mark a level line three feet below the ground the instrument stands on. After one line has been run in this way the target is adjusted at a height of three feet above its original height and the process repeated, thus running out a second contour line at three feet below the first. The instrument is then moved down, readjusted, and the process continued.

After these contour lines are located, different methods of terracing may be used. One of the simplest consists in back-furrowing along the contour lines with two or three turns of the plow after which by the use of the side hill or reversible plow the plowing is continued over the strip between the contour lines. The back furrow should be seen across the level line staked out so there will be a slight fall toward the sides of the field or grassed ditches. By plowing so as to throw the dirt all down for the first two or three years a fairly well developed terrace is produced. After this the soil should be thrown one way one year and the opposite the next time it is plowed. This method is especially helpful on lighter soils which have a larger power to absorb water.

In the case of heavy soils which cannot absorb water as fast as it falls, some combination of this slight terrace and of a ditch is necessary. This may consist either in cleaning out the last furrow on the lower side of the incline in each terrace so that it may serve as a slight ditch, or of reversing the direction of plowing after the first two back turns of furrowing have been accomplished so that by the use of the harrow the dead furrow may be turned into a shallow ditch just above the steeper portion of the terrace. When either of these methods is to be used, the plowed land should not agree exactly with the contour line, but should run across it at a very narrow angle so that the slight ridge produced will have a gentle fall toward the ravines at each end of the plowed land.

In developing these narrow lands, thought must be given to the tools which are to be used on it so that if a binder is to be used the width will give an even number of cuts so that the machine may be moved along the side hill at one end of the field without running empty across the field. Crops are planted in rows running obliquely across both ditches and dikes.

Protection of ravines and water courses.—Since it is frequently necessary to permit water to run down rather steep slopes the water courses may be paved with cobbles or stones which prevent the removal of soil to a large extent, or seeded with grass. the roots of which bind the soil. This latter method is most available. In producing such ravines and water courses, the greatest care is necessary to prevent their being seriously eroded before the grass is well established.

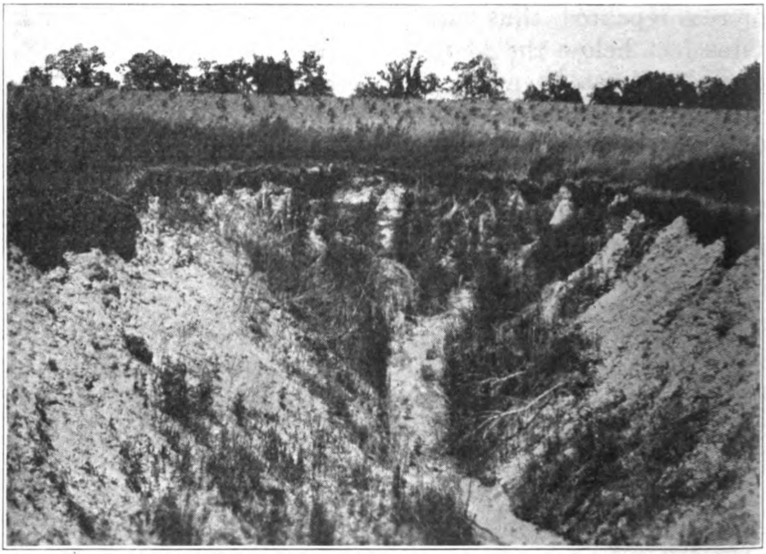


FIG. 9.—STOP THE WASHES EARLY

Such a ditch as this is a menace often to a whole 40-acre field. This one should be sodded over and willows planted in the bottom.

For this purpose it will usually be found most practicable to dig these ditches or straighten and even up ditches already existing in the early fall at which time comparatively little erosion takes place. By seeding these ditches at this time with rye which will grow in the fall and assist greatly in holding the soil in the spring, and then seeding in grass two or three times as thick as it would be in laying down a meadow, a good sod may be quickly developed so that by the time the heavy down-pours of June and July occur a very good protection has been produced.

On the level terraces or where heavy soil lies on unsubstantial sandy or gravelly subsoil, small ditches must be promptly attended to because in such conditions they are always dangerous.

Figure 10 tells the story of an unsuccessful attempt to cultivate all of the hillside slope the same season. This farmer liked large fields and not realizing the necessity of cultivating land on such a slope as this in narrow strips across the slope, he extended his ridge-top field down the slope and removed the timber on the lower part, till there was nothing to break the eroding force of the water flowing off from the ridge fields above.

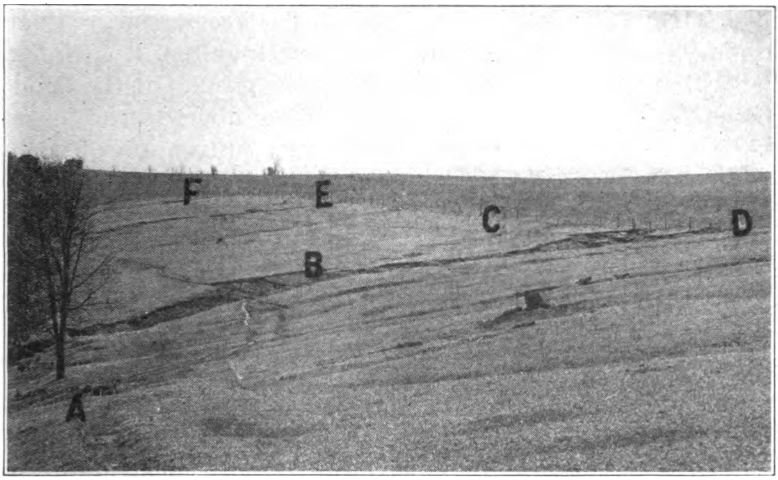


FIG. 10.—DITCHES WHICH COULD HAVE BEEN PREVENTED

A field largely ruined by erosion which could have been prevented by a little work at the right time.

The slight ridge along the edge of the woods at A indicates the former location of his lower fence and the back furrow along it when this field was cultivated. It was here too where the ditch B started and in spite of the tree and grass roots deepened itself on the steepest wooded slope below and then started up across the cultivated field to D.

At first this farmer by plowing across the ditch and shoveling the sides and filling the lower end with brush, straw, and logs, was still able to cultivate the whole field one year and then seed it down. But one or two severe storms in the spring of the year when the slope was bare produced such a volume and velocity of water that obstructions were undermined and the ditch deepened and widened till it is now 10 feet deep and 15 feet wide near the trees. This ditch now prevents the cultivation of this slope as far as the fence at C together with ditches E and F and threatens the plow land farther up at the top of the ridge from which valuable fertility and organic matter are being carried away. This ditch could be made to fill itself gradually by means of an effective screen or dam among the timber, and its further growth halted by keeping in continuous sod a sufficient piece of the ground at the head of the ditch all of which is now cultivated down to the fence and the head of the ditch. The correct cultivation of such land in narrow strips of alternate sod and cultivated field is shown in Figure 6.

Where the subsoil is clay and where clay or silt soil material is being carried by flood water, large gullies may be made to fill themselves by putting in a dam of stumps, logs, or brush Where the subsoil is sandy, more care is needed and dams need to be carefully constructed to prevent the water from undermining or cutting around them.

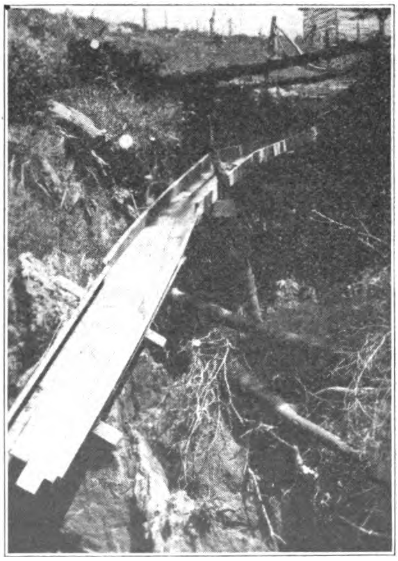


FIG. 11.—A FLUME PREVENTS UNDERMINING

Where the fall is great, a flume such as this serves to carry the flood water over the head of the ditch and prevents further undermining and extension of the ditch.

Dams of concrete stone, wire, mesh, boards, or brush, have been successfully used. Board flume devices have also been used to carry the water over the head of the ditch and down into it, preventing continued undermining.

Planting willows and bushes on the sides and bottom of ditches which are too deep to fill often arrests the growth of a ditch. Sorghum, sweet clover, or rye, make good emergency crops on eroded spots or fields which later need to be seeded to grasses and left in permanent sod.

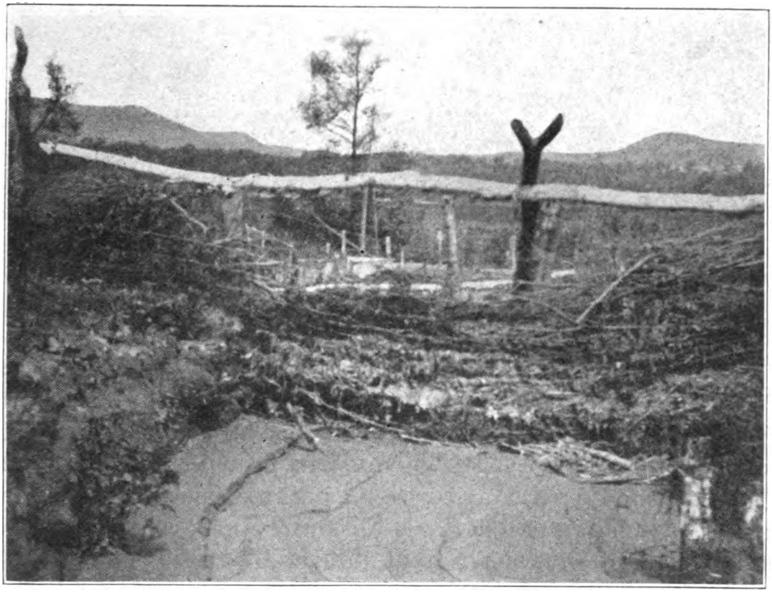


FIG. 12.—DAMMING A DITCH

A combination wire and brush dam such as this is often a good preliminary move in halting an actively growing ditch.

CUTTING TREES FROM HILLSIDES

When wood is to be cut on hillsides which are so steep that erosion is likely to occur it is best to thin out the trees gradually, allowing grass sod to develop which will hold the soil. By transforming wooded slope into pasture gradually, erosion can be prevented, while if the wood is all cut off at once, erosion will take place before the grass has had time to establish itself. Even if the land is later to be broken and used for cultivated crops, it will be found that the grass sod will greatly lessen erosion. By using such land in a rotation in which it is in a tilled crop but one year out of four to six years, serious erosion can usually be prevented where otherwise it would be certain to take place. Figure 13 shows the result of the sudden removal of the timber protection from a steep slope. The roots and litter in a wooded area furnish efficient protection from erosion.

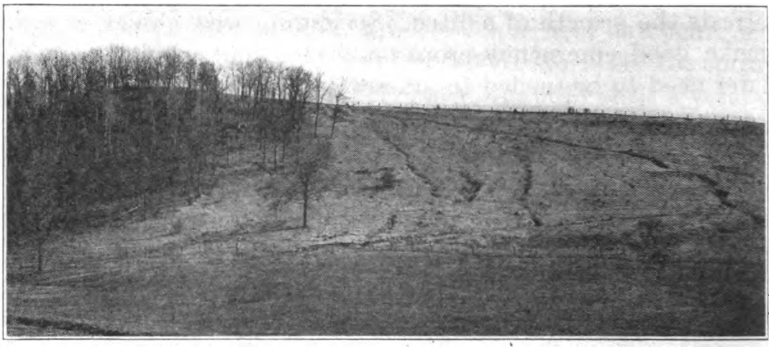


FIG. 13.—THE TREES PROTECT THE HILLSIDES

This illustration shows very clearly the danger of cutting all of the trees from side hills at one time and before grass has come in to protect the soil.

SPECIAL CROPS FOR SIDE HILLS

Much of the side hill land should be used for pasture, but in some sections of the state practically all of the farm is on side hills so that other crops must be grown. On such land the tilled crops such as corn and potatoes should be grown only to such an extent as is absolutely necessary. Crops which can be grown without danger of erosion should be substituted for corn as far as possible. Oats and peas grow together may be used, and alfalfa, sweet clover, or Brome grass are among the best hay crops for such land.

In the southwestern part of the state, most of the side hill land is underlaid by limestone, and alfalfa or sweet clover do exceptionally well. In seeding alfalfa on such land, care must be taken that the land is not injured by erosion before the crop becomes established. If the land can be plowed and seeded to rye in the fall and the alfalfa seeded early in the spring, this danger can be greatly reduced. The method of seeding alfalfa on land which is dragged or disced several times during the spring and the seeding not done until the last of May or in June greatly increases the danger of erosion, since the cultivation leaves the ground in a very loose condition and the rain storms causing the greatest amount of erosion most commonly occur during the early summer months.

Brome grass is well suited to such land, as its strong root system permits it to withstand drought to which such land is subject better than most other hay grasses.

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BIENNIAL REPORT

OF THE

STATE CONSERVATION COMMISSION

OF WISCONSIN

FOR THE
YEARS 1915 AND 1916

MADISON, WIS.
Cantwell Printing Co., State Printer
1916

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JAMES NEVIN, *Chairman*	Term expires February, 1921
W. E. BARBER	Term expires February, 1919
F. B. MOODY	Term expires February, 1917
R. S. SCHEIBEL, *Secretary.*	

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LETTER OF TRANSMITTAL

HONORABLE EMANUEL L. PHILIPP,
Governor of Wisconsin.

Sir:—In conformity with law, we have the honor to transmit the report of this department for the fiscal years ending June 30, 1916.

JAMES NEVIN,
W. E. BARBER,
F. B. MOODY,
Commissioners.

R. S. Scheibel, *Secretary.*

COMMISSIONERS' REPORT.

Pursuant to statutory direction, we take pleasure in submitting our first biennial report. The report involves a rather unusual situation. Although it covers the two fiscal years ending June 30, 1916, this commission did not come into actual control until August 1, 1915. Thus, the first thirteen months of the biennial period were under the individual administration of the several departments combined to create this commission, and officially we are only responsible for the last eleven months of the period mentioned. We, therefore, feel that we should necessarily be brief as to the administrations during the aforesaid months, and confine our remarks to a financial statement. Chairman Nevin of this commission having long been active as superintendent of fisheries under the old commissioners of fisheries, we are able to include complete information covering the old fisheries department.

By provisions of Chapter 406, Laws of 1915, this commission succeeded to all the powers and duties of the Forestry Board, State Park Board, Conservation Commission, Commissioners of Fisheries and the State Fish and Game Warden Department. The intent and effect was to consolidate under one head all the closely related duties and problems of administration over forest and stream, fish and game, and to give powerful impetus to the conservation of the natural resources of the Badger State.

So that the public may better understand the actual meaning and result of the consolidation we have prepared the following statement:

Salaried positions and honorary appointments under old departments

	Salaried	Non-salaried
State Park Board	none	3
State Forestry Board	2	5
Commission of Fisheries	2	7
Fish and Game Warden	2	none
Conservation Commission	none	7
Office clerks and stenographers	8	none
Total	14	22

Salaried positions and appointments under new department

Commissioners and secretary	4	none
Office clerks and stenographers	5	
Total	9	none

It will be noted that the consolidation resulted in reducing the number of salaried officers, clerks and stenographers from 14 to 9, and incidentally 22 members of boards and commissions were dispensed with. The saving in salaries in the administration end of the work, however, is of minor importance in the resultant economy. To this must be added the traveling expenses of the 22 commissioners. Under the old system each of the five departments issued its own annual or biennial report, a separate expense for the printing of stationery and office forms, and for postage, office supplies and equipment—five departments of state, all drawing from the public exchequer in practically a duplication of expenditures. The old forestry board, state fish and game warden and fish commission each occupied separate offices. The actual saving to the state cannot be placed at less than from ten to twelve thousand dollars.

Most important, however, is the increased efficiency in the services rendered the state. Politics has been absolutely abolished in our reorganization and a demand was made for strict attention to the work of our several divisions and particularly in the activities to conserve the wild life of the state. There is nothing so contaminating to efficient service of a department of this nature as political servitude. This commission is proud to say that our first instruction to every employee was that efficient service would be the measure of his tenure in office, and that his citizen's rights were matters of his individual preference. In making appointments to this department we adhere at all times to the State Civil Service laws. These policies have been strictly adhered to and will be as long as the present commissioners are at the head of this department.

Under the old régimé the state sustained five departments, all working entirely independently of one another, although the activities of all were so closely related that the work of one department overlapped or interwove with that of another. One department is now administering the affairs of five, and three men, who devote their entire time and attention, instead of twenty-six honorary commissioners, are responsible for the proper administration of the state's business along those particular lines.

Because of restrictions placed upon the activities of the old forestry board by the Supreme Court prior to the creation of this commission, the work on the forest reserves has been confined, chiefly, to that of protecting all state lands north of Town 33 from fire and trespass, the sale of dead, down, dying and mature timber, the maintenance of two forest nurseries, the sale of planting stock therefrom, surveying and leasing islands and lake lots, and other work incident to the proper care and protection of the property.

As the decision of the Supreme Court in no way affected the management of the state park properties, we have actively continued the improvement, care and operation of the several state parks as far as available funds would permit.

Joint resolution No. 32 passed by the 1915 legislature places with us the duty of presenting to the 1917 legislature a revision and codification of all fish and game laws. Pursuant to this action by the legislature, we immediately started investigations. After due notice was published, meetings were held with commercial fishermen at the following ports:

At Sheboygan on February..........14, 1916, 77 fishermen present.
At Green Bay on February..........15, 1916, 151 fishermen present.
At Sturgeon Bay on February....16, 1916, 103 fishermen present.
At Oconto on February................17, 1916, 46 fishermen present.

At Marinette on February............18, 1916, 50 fishermen present.
At Milwaukee on February..........23, 1916, 83 fishermen present.

These meetings were held for the purpose of gaining some knowledge directly from the licensed fishermen, on which to base our recommendations as to laws covering the commercial fishing industry on Lake Michigan and Green Bay. Five hundred and ten typical fishermen—men who have followed fishing in outlying waters for years—were present. If space would permit, we would like to print the minutes of the six meetings mentioned above, so that the reader might appreciate the varied and diversified ideas and opinions held by the fishermen. Not only do the fishermen of Sheboygan disagree with the fishermen of the other five ports (the same being true at all the meetings), but, also, the fishermen working out of the same port disagree among themselves. Hook fishermen say the pound-net and gill-net men are wrong, and vice versa. At the Sheboygan meeting arguments were made in favor of 2½, 2⅜, 2⅝, 2¾, 4, 4½ and 5 inch mesh for catching trout. The gist of the situation is that we, after a careful consideration of all the information secured, must present such a revision of the fish and game laws as we deem best and proper.

We take pleasure in commenting on the interest and vigor shown by the employees in the several divisions of this commission. It is refreshing to find an existing condition in that all our employees feel that they are all members of one big family, that their interests are all in common, and that they are working for a common cause—for the good of the department.

We wish to express the appreciation of this commission for the help and coöperation by the railroad companies in the distribution of fish planted in public waters. This assistance is invaluable in the final operations of our hatcheries. The rapid and expeditious transportation of the fish cans, the willing attitude of the railroads and their employees to assist whenever possible, are of great help in making our work a huge success.

We are also indebted to the Biology Department of the University of Wisconsin for assistance in problems that are of a more scientific nature. The University has always responded in a spirit most willing to assist us whenever possible.

The commissioners express to Mr. Arthur F. Belitz, assistant revisor of statutes, their thanks for the aid given in the revision and codification of the state fish and game laws.

BUDGET FOR BIENNIAL PERIOD ENDING JUNE 30, 1919.

Requested Appropriation: (Annual)

For General Operation	$200,000.00
For Repairs and Maintenance	13,000.00
For Property and Improvements	13,000.00
Total	$226,000.00

General Operation. ($200,000.00)

This expenditure includes all items of salaries, labor, supplies and traveling expenses. The amount is $30,112.54 below the total disbursements by the former Forestry Board, Park Board, Fish Commission and State Game Warden during the last year that these departments operated independently. The amount is practically the same as the amount expended for the purpose during our first year of operation. The amount is sufficient but we cannot properly administer the affairs of state under our direct supervision on a less amount. It is the same appropriation as given by the Legislature of 1915.

Repairs and Maintenance. ($13,000.00)

This expenditure includes the upkeep of all properties under our care, i. e., repairing of roads, all tools and equipment, painting and repairing of all buildings, and the upkeep of all hatchery ponds, raceways and pipe lines. Our inventory shows we have property and equipment representing an investment of $632,744.00. Being state property it is always expected to present the best possible appearance. Practically all of the ninety odd buildings need painting, many need a new roof, many miles of park roads need repairs, and the state boats, launches, engines and other equipment need overhauling.

For this purpose the Legislature of 1915 made an appropriation of but $5,000. It was the amount asked for the fish hatcheries alone and the approximate amount usually given that department. In the hurry during the last days of the session the amount was not changed and no provision was made for the parks, forestry and warden divisions. As a consequence some of our necessary upkeep work was left undone.

The amount asked for provides for the forestry, park, warden and fisheries divisions.

Property and Improvements. ($13,000.00)

This expenditure includes the erection of new buildings, building of new roads, new hatchery ponds, raceways or pipe lines, and the purchase of new tools or equipment. With 457,200 acres of land and property values amounting to over $630,000.00 under our control, it will be readily appreciated that the amount we ask for is not excessive.

The 1915 Legislature appropriated $4,000 for this purpose but the same is true as to the repairs and maintenance appropriation as explained above. It was only sufficient for the needs of the fisheries division.

Conclusion.

The total appropriation is some $26,000.00 less than the amount disbursed during the fiscal year ending June 30, 1915. It will also be noted that during the last fiscal year this department turned $227,261.40 into the treasury of the state of Wisconsin. We anticipate that the present year will see an increase of from ten to fifteen thousand dollars as last year the sale of hunting licenses was quite below the average, also the return on rough fishing was low. The commission is more than self-sustaining.

PROPERTY OF DIVISION OF
FORESTRY
COLLEGE OF AGRICULTURE
UNIVERSITY OF CALIFORNIA

RECOMMENDATIONS.

That all moneys collected by this department from the sale of licenses, confiscations, wardens' fees, proceeds from fishing contracts, concessions, leases (except Federal Grant Islands) or derived from any other source in the general administration of this department, be deposited with the state treasurer and be credited to what shall be known as the "State Conservation Fund." That an appropriation be made for the administration of our work in the usual manner. The surplus in the Conservation Fund over and above our appropriation or disbursements may be expended by this commission, with the consent of the State Emergency Board, for any special purpose such as additional equipment, new buildings, new hatcheries or hatchery ponds, property improvements or increasing the warden force at any particular period. Such money to be used for any of our work with the exception of road work or improvement work on state parks. The said Conservation Fund to be cumulative and nonlapsible.

FISHERIES DIVISION.

To reënact subsection 4 of section 172–22, statutes of 1913, providing a fund for the rescue of fish from the land-locked sloughs and bayous adjacent to the Mississippi river. This fund was repealed, unintentionally, by section 22, chapter 607, laws of 1915. At the time the repeal went into effect, August 26, 1916, the fund contained $9,843.36. The fund should be re-established with an appropriation of $10,000.00.

To place a law in the statutes, prohibiting the pollution of our inland waters through the cheese, condensed milk and canning factories carrying the refuse from their operations into the lakes and streams. This department to coöperate with the State Board of Health in the carrying out of the provisions of such law.

PROTECTION OF FISH AND GAME.

Pursuant to joint resolution number 32 by the legislature of 1915, we have prepared a complete revision and codification of the state fish and game laws and the same will be submitted to the legislature of 1917 in the form of a bill. We have spent a great deal of time in study and securing information on which to base this revision and we sincerely trust that the legislature of 1917 will bear in mind that our recommendations are the results of almost two years of study and research.

We herewith mention some of the most important changes we endorse:

1. A general open and close season over the entire state for all varieties of wild animals.. Repeal the many special county laws.

2. A close season over the entire state on partridge, grouse and prairie chicken.
3. Change the open season on wild birds from September 7 to September 26 and extend the season to December 31.
4. Change form of hunting license to smaller size and omit the deer coupons. Deer coupons to be furnished at an extra fee of 50 cents. Reason—out of 160,000 licenses sold only about 35,000 are used for deer hunting. Thus 125,000 licenses are printed, each with three coupons, which are never used for deer hunting. This will reduce the printing cost 50 per cent to 60 per cent and be more convenient for hunters and county clerks.
5. Reduce the limit of daily catch of trout from 45 to 25.
6. Prohibit the sale of black bass and muskellunge.
7. Provide a trapper's license for taking fur bearing animals.
8. To increase the nonresident fishing license fee from $1.00 to $2.00. The nonresident hunting license for small game from $10.00 to $25.00 and for small game including deer $50.00. That we issue a resident trout fishing license at a fee of $1.00.
9. Reduce the nonresident hunters' bag limit to the same as a resident hunter.
10. Change game farm license law to omit muskrat.
11. Change opening day for taking black bass from May 29 to July 1.
12. Place a daily bag limit on all varieties of game fish.
13. Change the sunrise and sunset law by allowing shooting 20 minutes before sunrise or after sunset.
14. A law as to the establishing of wild life refuges.
15. A law providing for the forfeiture of any license for the season for which it is issued, if the holder is found guilty of a violation.
16. Increase all penalties. Principally—$300 for the use of dynamite in killing fish, $100 for having venison in possession out of season, $200 for shipping game to market, $300 for serving venison in railroad or lumber camps, hotels or summer resorts.
17. An absolute close season for all fishing in Green Bay and Lake Michigan from October 20 to November 31 inclusive.
18. No pound nets to be used in Green Bay during the month of April.
19. Repeal all laws as to outlying waters and stipulate a minimum gill net of 2¾ inches stretch measure. Regulate the taking of fish according to size stipulating in the law the minimum size of each variety of fish that may be had in possession. Have a law that any gill net less than 2¾ inch stretch measure found set in the waters, or found on the boats or reels of fishermen operating in Green Bay or Lake Michigan may be seized by the state conservation wardens. (The law of the state of Michigan allows no gill nets to be used in outlying waters with meshes less than 2¾ inch stretch measure.)
20. Change deer law that bucks must have horns at least 6 inches in length.
21. To prohibit the carrying of a gun or rifle in any automobile, or other vehicle unless the same is unloaded, and knocked down or enclosed in a carrying case.

22. Change the clamming law to permit the use of a dredge with an opening not more than three feet wide or with prongs more than four inches in length. No clams to be retained that measure less than one and one-half inches in greatest dimension.

This is a matter of far greater importance than most people realize. In Wisconsin almost a million dollars is invested in the pearl button industry and thousands of people are employed. It has been known for some time that the clam shell beds were nearing depletion and that some law must be enacted to conserve the supply. In the fall of 1915 the former Commissioners of Fisheries called a conference at Madison. Minnesota, Iowa, Illinois and the U. S. Bureau of Fisheries sent representatives. Pearl button manufacturers from all over the United States and one shell buyer for an European manufacturer were present. The investigations were most exhaustive and a bill was prepared for passage in the 1915 legislature. Senator Robert Glenn, living on the banks of the Mississippi, introduced the bill known as bill No. .... S, which passed the senate but when it reached the assembly it was so amended as to be of no importance. Minnesota and Illinois passed the identical bill as introduced and which was drawn up by the conference. Here is one result of Wisconsin's failure to pass the measure. Minnesota passed the bill, the waters of the Mississippi river between the two states are now considered as interstate waters under the reciprocal law between the two states. Minnesota sells her clammers a license to use a dredge, Wisconsin does not—Minnesota clammers are taking hundreds of tons of shells and our own people must sit by and see thousands of dollars slip through their fingers. The price of pearl button shells has raised from $8.00 to $32.00 per ton, the highest price ever known. The Wisconsin clammers have lost thousands of dollars.

23. That the commission be given the authority, in cases of emergency, to shorten or close any open season, or reduce the bag limit, or prohibit the catching of fish in any certain lake or stream.

FORESTRY AND PARK DIVISIONS.

1. A state-wide forestry policy.
2. The management of state lands in so far as the constitution will permit, by the state conservation commission.
3. That areas suitable for agricultural development be sold to bona fide settlers in small tracts (not over 160 acres).
4. That the scattering state lands be sold, since it is impossible to protect them from fire.
5. That the policy of leasing islands and lake lots be continued.
6. That the state forest nurseries be maintained and forest planting be encouraged throughout the state.
7. That the work of forest fire protection be extended over the entire wooded portions of the state through the coöperation of timber owners.
8. That the coöperative fire protection agreement with the Federal Government be continued. (Weeks Law)
9. That the forest fire laws be amended and strengthened.

10. That Trempealeau Mountain be accepted by the state as a state park and funds be provided for its management.
11. That the development of state roads within all of the parks be continued and adequate funds appropriated for this purpose as well as for the general upkeep and care of the properties.
12. That an appropriation of $40,000 be made to purchase the remaining interior holdings within the Devil's Lake and Peninsula parks.

We recommend that authority be vested in this commission to sell equipment or other paraphernalia when it is deemed to the advantage of the state, the proceeds of such sale to be credited to the department funds. We oftentimes have articles of equipment that are of no further use to the commission and which should be sold while still having a monetary value. As an instance, in 1915 the state had an old fish car that had been in use for over 20 years. It was necessary to purchase a new steel car as the railroad companies were prohibited from carrying it on passenger trains consisting of steel cars. The original purchase price of the old car was $5,000 and we had an opportunity to sell it to the Canadian Government for $3,500. The sale however could not be consumated until the 1915 legislature enacted a special law authorizing us to dispose of that one piece of worn-out equipment.

James Nevin,
Chairman.
W. E. Barber,
Commissioner.
F. B. Moody,
Commissioner.

Attest:
R. S. Scheibel,
Secretary.

DIVISION OF FISHERIES.

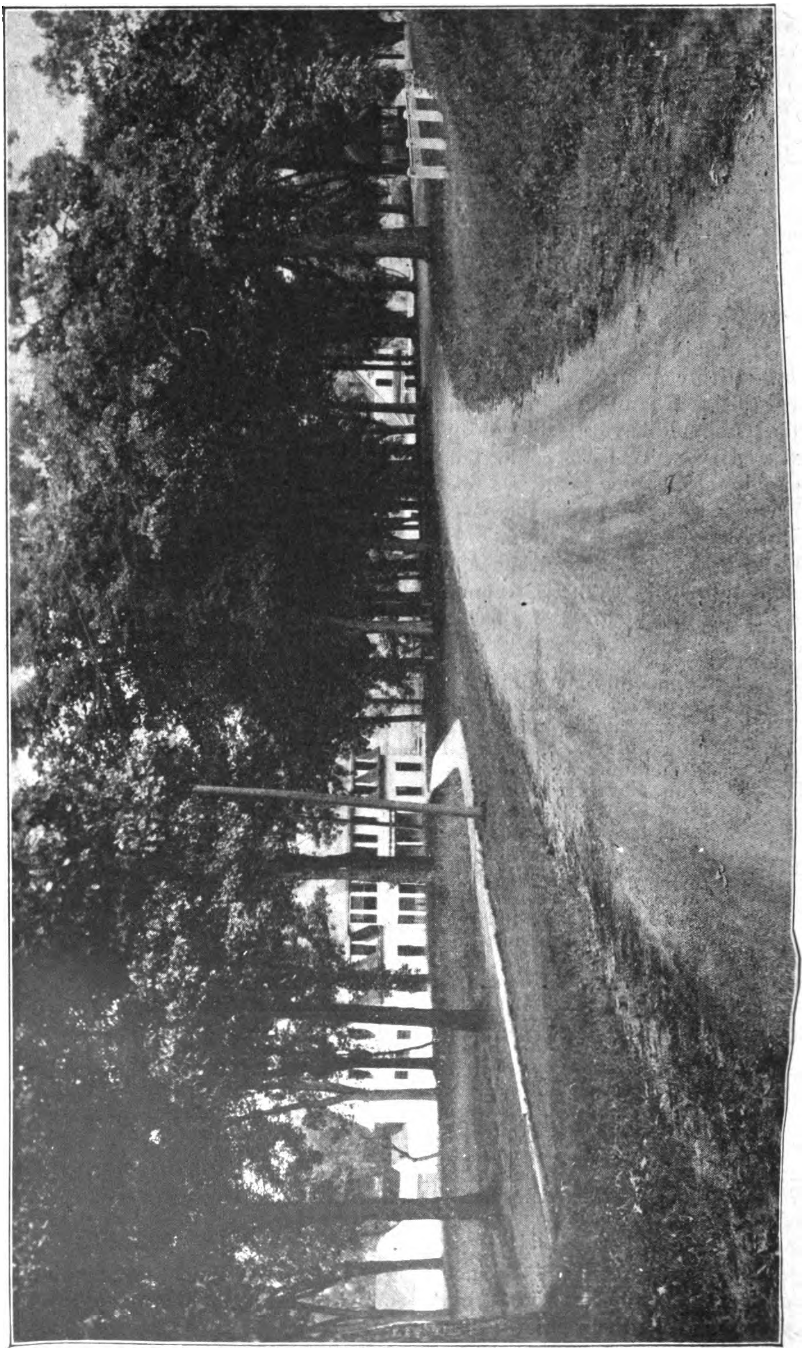
By JAMES NEVIN.

It was in 1882 that I first became identified with Wisconsin's work in fish culture and for 33 consecutive years I held the position of superintendent of fisheries under the old Commissioners of Fisheries. It is only natural that I should have a feeling of sentiment at the passing of the old commission with which I was connected for so many years. Memories both sad and pleasant come to me as I read the names of the gentlemen with whom I was associated during the past thirty-three years. Many of them have passed to the great beyond. The roll of honor is large and one of which I am proud. These gentlemen served the state as commissioners of fisheries with no thought of recompense, freely and gladly giving their best efforts to the building of a fisheries department of which Wisconsin may well be proud.

*Hon. Philo Dunning	Madison
Hon. C. L. Valentine	Janesville
*Hon. Mark Douglas	Melrose
*Hon. John F. Antisdel	Milwaukee
*Hon. James V. Jones	Oshkosh
Hon. Chris Hutchinson	Shullsburg
Hon. Calvert Spensley	Mineral Point
*Hon. A. V. H. Carpenter	Milwaukee
Hon. E. S. Minor	Sturgeon Bay
*Gen. E. E. Bryant	Madison
Dean E. A. Birge	Madison
*Hon. Geo. F. Peabody	Appleton
Hon. Wm. J. Starr	Eau Claire
Hon. C. G. Bell	Bayfield
*Hon. James J. Hogan	La Crosse
*Hon. Henry D. Smith	Appleton
Hon. Jabe Alford	Madison
Hon. A. A. Dye	Madison
Hon. A. L. Osborn	Oshkosh
Hon. Geo. B. Hudnall	Superior
Ex-Gov. Jas. O. Davidson	Madison
*Ex-Gov. G. W. Peck	Milwaukee
Hon. John C. Burns	La Crosse
Hon. B. C. Wolters	Appleton
Hon. Edw. F. Kileen	Wautoma

*Deceased

The change, however, was inevitable, and, in my opinion, the creation of the present Conservation Commission is one that should have occurred years ago. I will be brief in my report covering the Fisheries Division,



DRIVE ON STATE HATCHERY GROUNDS NEAR MADISON and confine my remarks to what may be deemed important, interesting and to what should be printed for the information of those interested in fish culture by the State of Wisconsin. I wish, however, to elaborate somewhat on the subject of the conservation of fish and the necessary restrictions in the taking, catching and killing of fish in our state.

On the following pages will be found full and complete statistics covering the output of our seven permanent hatcheries and three substations. These tables give a complete statement as to the output of each hatchery, varieties of fish hatched and planted, cost of operation, inventories, acreage, and value of lands, buildings and equipment.

HATCHERY IMPROVEMENTS.

Since the issue of the last report by the former Commissioners of Fisheries, the state established what may be called a "sub-station" in Tenney Park, Madison. This hatchery is operated only during the spring hatching period, and is equipped for the propagation of wall-eyed pike and pickerel.

An important improvement was made at the Bayfield Hatchery during the past year. The conduit carrying the water from Birch Run pond to the hatchery has been extended up through the pond so as to take the water from the headwater springs. The extension is of twelve-inch vitrified pipe and increases the length of the pipe line some 900 feet. By taking the water directly at the springs we hope to remedy the following trouble. In the spring when the young trout are in the hatchery troughs, the rains and melting snow cause a heavy wash into Birch Run creek and pond. These heavy spring floods are caused by the lands being cleared for cultivation in recent years. The timber and brush has been cut, the lands have been plowed and each rain causes a heavy surface wash. The soil is a red clay and the spring floods wash the soil into minute particles, carrying it into the pond in such great quantities that the water is turned a distinct red. These clay particles are carried through the conduit into the fry troughs, and the clay adheres to the gills of the little trout causing their death by thousands. We expect to overcome this clay-water by taking the water supply, as I stated above, from the head-water springs.

It is the intention of the commission to build a number of fry ponds at the head of Birch Run and in which we will hold and raise a great quantity of our spring hatch of trout, until they attain the fingerling size, such fish to be for fall planting.

The barn at the Bayfield station was destroyed by fire on the afternoon of September 22, 1916. The fire was caused by lightning. The loss of the building and contents was approximately $1,500.00, which was covered by state insurance.

The Oshkosh Hatchery was moved from the former location in the North Shore Park to a lot the commission purchased on the river bank. The property has a 150 foot frontage on River street. The reason for the change was because in the old location the hatchery was not giving satisfactory results in the output of fry. This unsatisfactory condition was caused by the water supply which did not afford the proper quality of water for the hatching of fish eggs. At the new location the water supply is taken by pumping direct from the river.

FISH DYING IN INLAND LAKES.

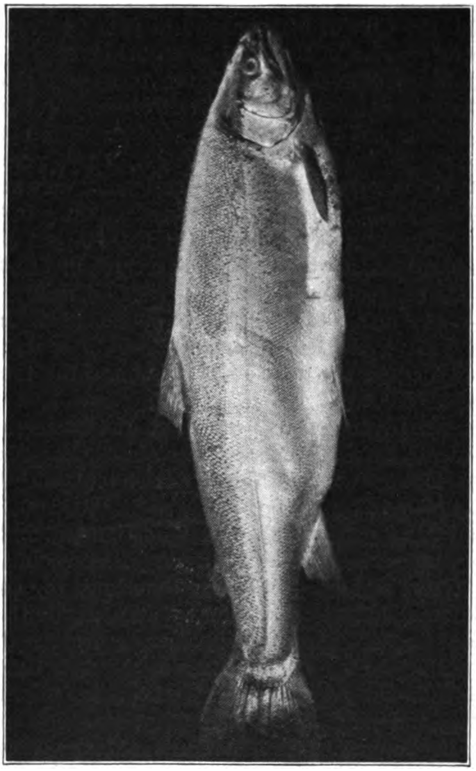
During the spring of 1916 we received more than the usual number of complaints as to large numbers of dead fish being found in our inland lakes after the ice went out. Several investigations were made, but the conditions were neither serious or alarming. For some reason the winter of 1915–1916 seems to have been a bad season for the wholesale dying of fish all over the state. As a rule it was found that the lakes in which the most dead fish were found, were lakes containing what may be termed an overpopulation of fish. Also the lakes were in some valley and the heavy snows of last winter were blown onto the ice in deep drifts. With this blanket of snow the ice was protected and the extreme cold weather did not crack and heave the ice. This prevented the water from throwing out the gases. The gases accumulated, air or oxygen could not get into the waters and the fish smothered. The dead fish were almost entirely sunfish and crappie; very few pike, pickerel or bass were found. This is not an unusual occurrence. It is not an epidemic or disease, but simply a dying off of the fish for want of air.

NECESSARY LEGISLATION.

The operation of fish hatcheries alone will not maintain our supply of fish for future generations. The work by the hatcheries must be strengthened by reasonable conservation laws, which laws must be rigidly enforced. Nature is very kind to her children—if they live in harmony and walk parallel with her laws. Permit the catching of fish during the spawning season, permit the catching of immature fish, stipulate no limit as to pounds or number of fish in possession, have penalties so low that the dynamiter and gill netter are always willing to "take a chance,"—then fully fifty per cent of the work by the hatcheries is lost before the millions of fish planted in public waters by the state have an opportunity to show results. Conservation does not mean hoarding our fish and game as a miser does his gold; it means to permit the taking, catching and killing of fish and game in such manner, at such times, and in such quantities as will conserve the supply for future years.

So that the reader may more readily understand the enormous drain upon our inland fisheries and appreciate the need of more stringent laws, I wish to state a few facts that will enable the people of our state to better understand the situation. During two weeks in June and the months of July and August, 1916, 865 boxes of game fish, each box weighing 20 pounds, were shipped from Woodruff, Oneida county, Wisconsin. A total of 17,300 pounds of pike, pickerel, black bass and muskellunge. Think of it! From one small northern station, having a population of only 329 souls, and there are hundreds of small summer resort stations just like it in northern Wisconsin from which game fish are shipped in like quantities, Add to this the pounds of fish consumed in northern Wisconsin in camps, summer homes and summer resorts—for every pound of fish shipped two pounds are consumed locally.

Resort owners agree that the summer of 1916 was the biggest year of history. The hot weather in the cities compelled our people of the middle west to hunt for a place to rest, and the resort owners reaped the benefit. Two special trains were run into the Manitowish, State Line, Minocqua, Woodruff and Eagle River regions every night. Chicago sends an average of 150 persons into Wisconsin every night during the season. It is quite impossible to grasp the situation. Northern Wisconsin every year is more and more invaded by fishermen. It is stampeded by a horde of men, women and children. *Figures run into millions of dollars spent.*



RAINBOW TROUT CAUGHT IN LAKE MICHIGAN NEAR RACINE, WISCONSIN. WEIGHT 11 POUNDS, 1 OZ.

We are often asked for estimates as to the pounds of fish caught with hook and line in the inland waters of the state, the value of same and the amount of money spent in the state by summer tourists. These are questions impossible to answer with any degree of exactness. All estimates are, to a greater or less extent, purely guesses. Working on a basis of averages and securing what reliable information is available from the conservation wardens who examine all shipments of fish on passenger trains passing through the larger cities, looking for possible violations of the state game laws, figures can be given that may be considered as close to the actual amounts as is possible. Wisconsin has some three thousand lakes both large and small within its boundaries, and thousands of miles of rivers and streams. Almost every lake and stream produces several edible varieties of fish.

During the summer of 1916, some 27,000 nonresident fishing licenses were sold in Wisconsin. It is estimated that 800,000 pounds of fish were shipped through the City of Milwaukee last year by nonresidents in the north and central portion of the state to their homes and friends outside of Wisconsin. In addition thereto it is fair to assume that one-half this amount, 400,000 pounds, were shipped out of the state and not passing through Milwaukee, and that 1,000,000 pounds were consumed within the state. Wisconsin has a population of about two and a half million. If one person out of twenty goes fishing occasionally we would have a total of 125,000 persons, including men, women and children, in the entire state who go fishing. Say that each person catches 10 pounds of fish during the whole fishing season, it would represent a catch of 1,250,000 pounds of fish caught by the residents of Wisconsin. All told, residents and nonresidents would have taken a total of 3,450,000 pounds of fish from our waters with hook and line. Fresh fish bring from 15 to 20 cents a pound on the retail markets. Reduce the price to 10 cents and the total catch would have a value of $345,000.00.

As to the financial value of the summer tourist business; if each of the 27,000 nonresidents who came into Wisconsin spent $50.00, they left $1,350,000.00 in the state. They shipped out or took with them 1,200,000 pounds of fish worth 10 cents per pound, or $120,000.00. This does not include railroad fares paid. The average estimated amount of $50.00 spent is the very lowest amount for which any person could enjoy a week's sojourn in our resort regions. There are thousands of people who spend their entire summer in Wisconsin, many stay a month or more, and many for several weeks. These people leave several hundreds instead of $50.00 in the state. This estimate, bear in mind, is based only on the 27,000 nonresidents who purchased fishing licenses. Women who do not wish to ship fish, and children less than 16 years of age are not required to purchase fishing licenses. Not 30 per cent of the nonresidents, counting women and children, coming into Wisconsin purchase fishing licenses.

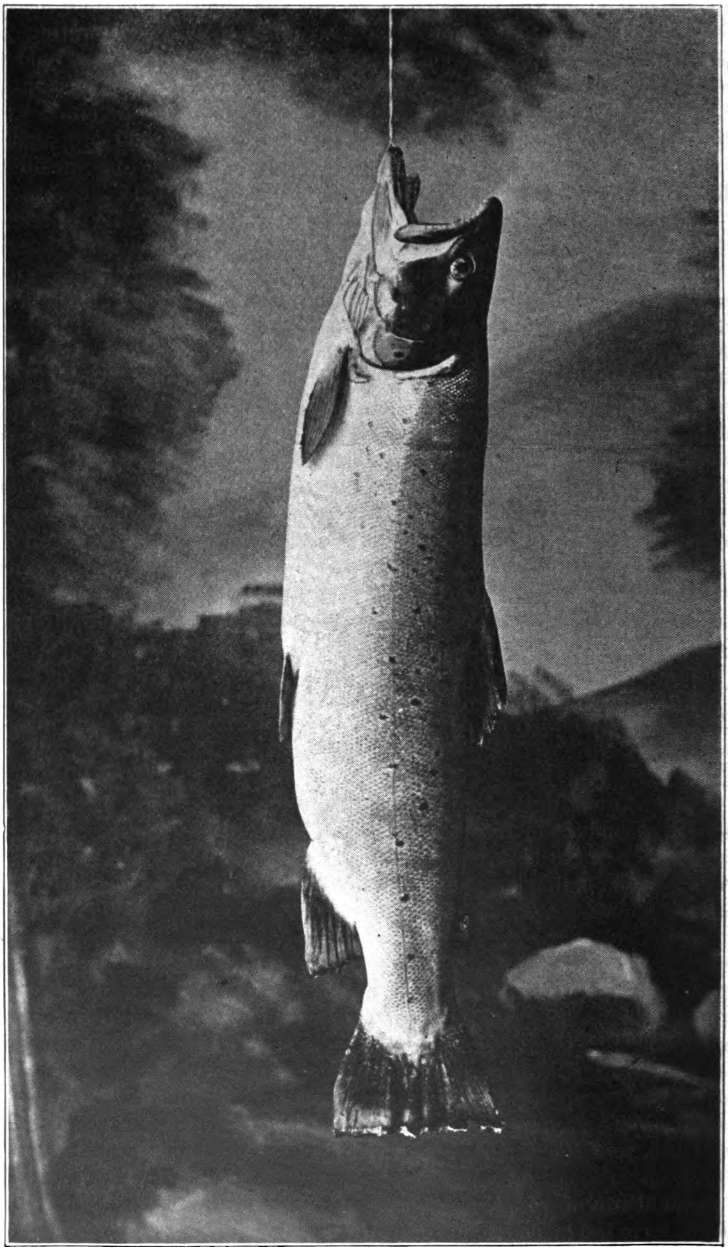
There are many and peculiar conditions to consider in an estimate of the worth of the Wisconsin waters and fishes. It is practically impossible to submit figures that may be considered at all reliable. However, I feel secure in making the statement that if anything, the figures I have given are very low. The value of our lakes and streams and the fish therein is inestimable. Wisconsin was quick to realize the worth of this tremendous natural resource and 42 years ago took the initial step for the perpetuation of fish life, in creating a Commission of Fisheries. The present generation is enjoying the results of the past work of the fisheries department and there is much in store for the enjoyment of future generations. The state spends annually about $110,000.00 for the protection and $50,000.00 for the propagation of fish and game. The total income to Wisconsin from the various sources connected with the hunting and fishing, such as summer resorts, tourists, and additional taxes paid by the railroad companies because of their great increase in business in the resort regions, may be safely placed at some five million dollars a year. What moneys Wisconsin disburses for the protection and propagation of fish and game is returned many times by the thousands of nonresidents who yearly spend their summers and vacations in the state.

There is not a man in our state interested in the commercial fisheries of the Great Lakes and Green Bay who will not agree that the law covering the taking of fish from those waters is a farce; more than that, it is ridiculous. Every man knows that something must be done to conserve the fisheries of the Great Lakes. To secure coöperation and a united agreement as to the proper laws among fishermen is an impossibility. The fishermen of every port have their own ideas, and the gist of their idea is that they want no law at all. There is one point on which most of them will agree and that is "Catch fish how, when and where you will,—any size and any quantity." At every session of the Legislature new laws are enacted and old laws repealed. The laws of 1915 contain 15 pages of tables supposed to cover the taking of fish from outlying waters. These 15 pages convey little or no information to the person reading them and it is practically impossible today for any one to say just what the Wisconsin laws are relative to the taking of fish from Lake Michigan and Green Bay. Our laws on commercial fishing must be condensed to the following:

The minimum mesh of gill nets.
An absolute closed season on all varieties of fish.
A law covering restricted areas.
The regulation of the taking of fish by stipulating in the law the minimum size of each variety of fish that may be had in possession.

Cut the law down to these four items, have them just and reasonable, within the bounds of true "conservation" so that the commercial fisherman can obey the laws, *then enforce the law.* Such a law is simple and every person reading it will understand it. Illinois, Minnesota and Michigan all regulate the size of fish. The entire Dominion of Canada regulates its fishing industry by stating in their laws in plain English the minimum size of each variety of fish that may be had in possession during the opening season. Fish less than such size are confiscated whenever and wherever found, and the person having them in possession is brought into court and fined. It is immaterial whether the person having them in possession is a fisherman, fish dealer, or cold storage man—he is violating the Canadian law by having them in possession or under control. What is the result? The merchants and wholesale fish houses refuse to accept under-sized fish, and the fishermen regulate the size of their mesh and their fishing operations so as not to catch immature fish. The law as to size of mesh, depth of water or distance from shore is all nonsense. As I state above, have the law cover the following:

1. No gill net of a mesh less than 2¾ inch stretch measure.
2. No gill nets of any variety to be set or used within one-fourth of a mile of any harbor, pier or breakwater, or any stream emptying into Lake



GERMAN BROWN TROUT CAUGHT IN WAUSHARA COUNTY, WISCONSIN. WEIGHT 8¾ POUNDS.

Michigan, Lake Superior or Green Bay, or within one-fourth mile of the shore line of Door county, or in any of the harbors or bays of Door county.

3. An absolute closed season in Lake Superior during the period from September 15 to November 1, and in Lake Michigan and Green Bay during the period from October 20 to December 1.

4. Stipulate the minimum size of lake trout, whitefish, chub, herring, bluefin, pike, pickerel and other fish that may be caught, had in possession or under control.

The statistics on Lake Michigan and Green Bay show that last year the state licensed the use of 12,533,665 feet or 2,375 miles of gill nets. Do you realize this means that if the licensed gill nets were joined they would reach from New York to Chicago, to St. Paul and then down to the City of New Orleans? Over two million set hooks were used. It is said that a man cannot count a million dollars, one at a time, in a life time. This will give you some understanding as to the dire necessity of placing upon the Statutes of Wisconsin, fishing laws that are truly in the light of conservation, laws that should be simple, each to understand, laws that may be enforced and laws that, when violated, the violater may be brought into court and the state be able to secure a conviction.

DISTRIBUTION OF FISH.

A great majority of the people interested in the planting of fish are of the opinion that because the fish hatchery is located in their midst, nothing further is necessary to furnish fry for distribution. They do not understand that we must either have a large number of breeding fish on hand, or that we must catch a large number of mature fish during the spawning season to obtain eggs for hatching. Brook and rainbow trout and black bass are the only varieties of fish that we raise for propagation purposes, and keep in our ponds, from which to obtain eggs for the hatchery.

At the time we started the 1916 distribution of fry, our files contained approximately 17,000 applications for fish of the various varieties. These applications were received from every part of the state. All told, approximately 206,000,000 fry were planted in the waters of Wisconsin by this Department. Of this number, some 140,000,000 brook and rainbow trout, pickerel, pike and muskellunge were planted in inland waters. The remaining 66,000,000 consisted of lake trout, whitefish, bluefin and chub, which were planted in the outlying waters of the Great Lakes and Green Bay.

The following table will show how the eggs of the different species of fish vary in size. We use as a basis the number of eggs per quart.

Brook trout average	13,000 to the quart
Rainbow trout average	10,000 to the quart
Lake trout average	7,000 to the quart
Wall-eyed pike average	150,000 to the quart
Whitefish average	40,000 to the quart
Muskellunge average	50,000 to the quart
Bluefin average	120,000 to the quart

The prevailing color of fish eggs in healthy condition is of an amber hue. If the eggs have not been properly fertilized or if there has been an undue change in temperature, or if the eggs were not properly handled, those that die immediately turn white.

When the eggs are received at the different hatcheries they are all measured and in this manner we know exactly the number of eggs received. All poor eggs removed are measured and by subtracting the loss of eggs from the amount received at the hatchery, it is very easy to determine the approximate number of fry that the hatchery produces and ships out for planting in the waters of the state. Dividing the total production of the hatchery by the number of cans used to make the distribution gives the number of fry per can, and by multiplying the cans by the number of fry in each can, we arrive at the number of fish planted by each person applying for the same.

During the past three months the employees of the commission traveled over 46,000 miles in the distribution of fish and the planting of them in public waters. The fry was transported in specially constructed cans similar in shape to a ten gallon milk can. It required over 16,000 of these ten gallon cans to transport the fry and at certain times it is necessary to curtail the shipments, as the empty cans are not returned as rapidly as is necessary. Oftentimes persons receiving the fry do not return the cans to the depot promptly, and this hampers us greatly in our work of distribution.

ROUGH FISHING OPERATIONS.

During the season of 1915 the Commission entered into 36 contracts under sections 62.38 and 62.50 for the taking of buffalo, carp, dogfish, garfish, ellpout, suckers and sheepshead from inland waters. Six of the contracts were under sec. 62.38 covering the waters of Winnebago county and thirty covering other inland waters. Most of the rough fishing operations were carried on in Lakes Poygan, Winneconne, Butte des Morts and Winnebago in Winnebago county, and in the waters of the Crawfish and Rock rivers, Lakes Monona, Waubesa, Kegonsa and Beaver Dam. Under section 62.38 the fishermen paid the state at the rate of one-half cent per pound on all fish sold and under section 62.50 the state collected one cent per pound. All fishermen paid a per diem of $2.50 plus necessary expenses including lodging and board for the services of a state supervising warden.

Most of the fish were sold in eastern markets, carp bringing from 3 cts. to 6 cts. per pound, buffalo from 5 cts. to 10 cts. Several carloads of live carp were transported to New York in a car especially constructed for this purpose. These fish were shipped from Hubbleton and Beaver Dam.

To make rough fishing successful under these contracts, requires the investment of considerable capital. It also requires one who understands the business of fishing and operation of nets. Many fishermen lost money because of their inexperience. This work is practically confined to waters in the southern portion of the state; northern waters are not heavily infested with the rough fish. Very few game fish were taken in the nets. Our game fish do not remain in the vicinity of a large school of carp or buffalo. When a particularly large haul of carp was made, 40,000 to 60,000 pounds, not over 75 to 100 pounds of the better varieties of fish would be found in the haul.

The following table will show that the 36 contracts yielded a total catch of 1,381,168 pounds of fish marketed and on the same the revenue of the state amounted to $11,128.07. Approximately 300,000 pounds of dogfish, ellpout and garfish were caught, which were buried on the shores.

Where the carp has established himself it is practically impossible to exterminate the fish, but consistent fishing will restrict their numbers to such an extent that the better varieties of fish may hold their own. Wherever the carp establishes himself it is not long before he becomes the dominating factor. The natural increase of the fish is exceedingly rapid and owing to its destructive habits the other varieties rapidly diminish. They simply crowd out the game fish and usurp the grounds. Some objections are made as to carp or rough fishing operations on the ground that seining the lakes does more harm than good. The season for rough fishing is from September 20 to March 20, at a time when the game fish are not spawning, are in deep water and for this reason there is practically no damage to the game fish. The fact stands that the carp will destroy more spawning grounds and water vegetation than all the seining that could be carried on. Lake Kegonsa in Dane county before carp fishing was carried on was practically a big carp pond. After three years of carp fishing operations, the summer of 1916 was the best game fishing season that the lake afforded for years. The water vegetation is now heavy and there are a number of splendid wild celery beds in the lake. There is absolutely no question as to the excellent results of cleaning the lake of tons of rough fish.

CATCHING WALL-EYED PIKE FOR COLLECTION OF SPAWN

ROUGH FISHING OPERATIONS.

	Lbs.
Winnebago county waters (Sec. 62.50)	333,840
Rock river (Sec. 62.38)	158,162
Crawfish river (Sec. 62.38)	77,145

Lake Monona (Sec. 62.38)	165,465
Lake Waubesa (Sec. 62.38)	96,985
Lake Kegonsa (Sec. 62.38)	210,872
Lake Beaver Dam (Sec. 62.38)	239,307
Other waters (Sec. 62.38)	99,392
Total pounds marketed	1,381,168
Revenue collected by the state	$11,128.07
Number of contracts entered into	36

SURVEY OF TROUT STREAMS.

For several years I have recommended a thorough survey or examination of trout streams in the state, so as to secure positive information as to whether or not the proper and necessary conditions exist to make the planting of trout successful. Many waters that at one time were excellent trout streams no longer have the proper natural conditions for the development and growth of this species of fish. The timber and brush have been cut from the banks, and the stream now meanders through farm and pasture lands, where, during the summer months, hogs and cattle wallow in the waters. Rains, owing to the timber and brush being cut, cause a heavy wash and flood. There is no question but that many thousands of trout from the state hatcheries are planted in streams in which the fish cannot exist. What may have been a good trout stream a decade ago is to-day nothing but a dirty, roily creek.

This year we started the work of a survey covering Wisconsin trout streams. A complete investigation is made as to the present conditions, i. e., temperature of water, depth, width and length of the stream, food conditions, results of former plantings, or any information that may have a bearing on the subject.

Many persons are of the opinion that water is all a fish needs. We may as well say that air is all a human being needs. A stream may be as pure and cool as spring water and as clear as crystal, if the necessary water vegetation which produces crustacea and caddis is absent, the planting of trout is useless. Crustacea is a form of animal life belonging to the fresh water shrimp family. This food must be abundant in the waters or the young trout cannot survive as it is the only food on which a baby trout lives during the first few months of existence.

The work was started in the southern part of the state and thus far ten counties have been covered. The survey is in charge of Mr. B. O. Webster, foreman of the Delafield State Hatchery, who with one assistant traversed the country in an automobile. By placing additional men on the work we expect to complete the undertaking during 1917.

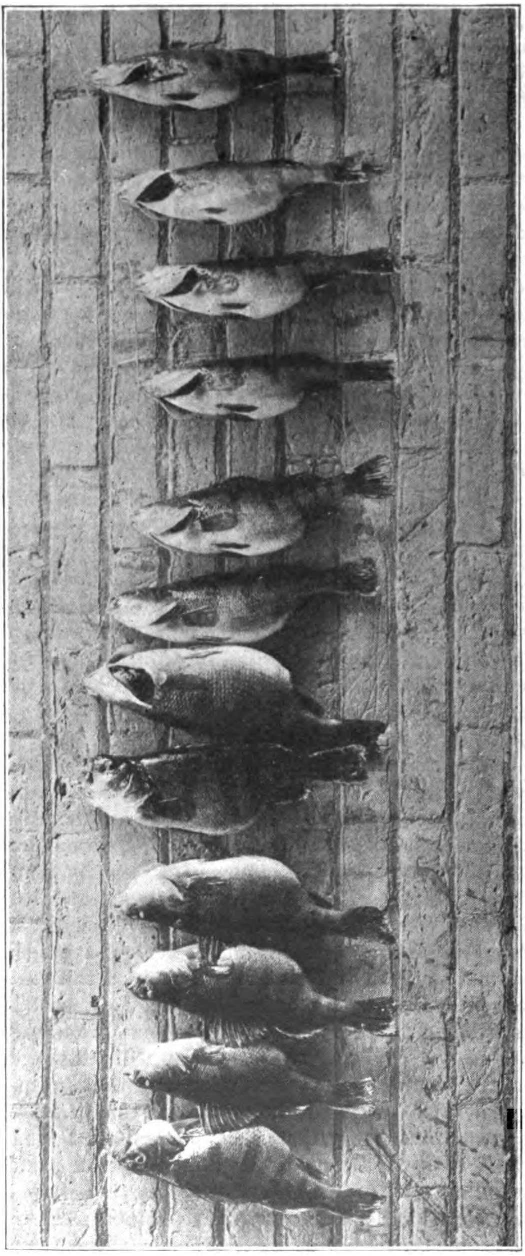
After the work has been completed and statistics tabulated, the department will be able to arrange the future distribution of trout fry so that the fish will be planted only in streams where we know they will find proper conditions for growth and reproduction. Hundreds of thousands of fry have been planted in streams in which a trout cannot survive. Many trout streams are now polluted with refuse from creameries, cheese and canning factories. This survey also covers the situation where persons secure trout from the state, and then post the streams "No Fishing Allowed." At the expense of the state and the taxpayer they maintain a good trout fishing stream. In the future such streams will not be supplied unless the public may enjoy the fishing.

During the past season unusual and remarkably large catches of pike and bass have been made with hook and line in the waters of Lake Winnebago and its tributaries. A peculiar condition was the catch of white bass in those waters, being all of practically uniform size and smaller fish, few if any of the large white bass as of former years being caught. Summer resorts reported splendid fishing throughout the north territory. This is also true all over the state.

Since the advent of the automobile trout fishing particularly has suffered. In my opinion the auto is the great cause in the rapid depletion of our fish and game. With an auto, hunters and fishermen can cover as much territory in one day as formerly took a week. The sportsmen can run from one hunting ground or trout stream to another, covering several in a day, even though they be miles from one another. The streams are fished out as fast as the state stocks them. We have a minimum size law, but, nowadays trout fishermen seem, as a rule, to be fishing for numbers instead of the size of fish. Unless a reduction is made in the daily bag limit, I am in fear that we will be unable to keep our streams properly stocked.

In our general recommendations we will cover the change in the law reducing the bag limit on trout and lengthening the closed season on black bass, but I wish to make a few particular remarks regarding these two changes. We intend to reduce the bag limit on trout from 45 to 25. Any true trout fisherman will admit that in this day and age, a catch of 25 trout in one day should satisfy any fisherman.

As to black bass. For many years I have advocated a law permitting no bass to be caught until July first. Of all Wisconsin fishes, the black bass is the only game fish of importance that builds a nest and protects the eggs and young fish. From the time the eggs are deposited on the nest until the young are about 10 days old, the pair of old bass continually remain in the immediate vicinity, driving away any enemy that may seek to destroy the eggs or young. The present law opens the season for the catching of bass at the very time the bass should be protected, i. e., at the time the fish are on the nests. You may take a general average for 10, 20 or even 40 years, and you will find that the bass are on their nests during the month of June. Not one year out of ten will show that black bass have left the spawning grounds by June first, or years when they are still on the grounds in early July. Any real fisherman will tell you that if you will keep out of the shallow bass grounds in June that no bass will be caught. Some fishermen make the hue and cry that if fishing for all varieties of fish except bass is opened on May 29, that they cannot help catching black bass. Let the fishermen keep out of the bays and shallows during June and no bass will be caught. Go out on the lakes on May 29 and see where the men are fishing—every boat is up in some bay among the lily pads or on some gravel bar where the small-mouthed bass spawn—and all the men will be casting for bass. The fishermen destroy millions of bass every year. If the reader is one of those who fishes for black



TWELVE YELLOW PERCH. TOTAL WEIGHT 16 POUNDS. TAKEN FROM LAKE KEGONSA, DANE COUNTY, WISCONSIN

WALL-EYED PIKE FROM TOMAHAWK LAKE, ONEIDA COUNTY, WISCONSIN bass during June he will admit, if he is truthful, that practically every female he caught was full of spawn. Give the black bass a chance to spawn and reproduce, and Wisconsin will always be one of the best black bass fishing states in the Union. The natural reproduction of young bass in the spring of 1916 was much better than the average year. This is due to the fact that the bass spawned late, the early fishermen quit after four or five days fishing on the spawning beds. Later the bass came in and many of the mature fish that would have been caught earlier in the season were left undisturbed, and the result was a good crop of bass fry. This condition means thousands of dollars to future sportsmen.

On the following pages will be found papers by Mr. John H. Lowe, of the University of Wisconsin, and Mr. R. L. Ripple, foreman of the Bayfield State Hatchery, regarding the use of gasoline and benzine in the treatment of trout attacked by a parasitic copepod commonly known as "fish lice" and causing an infection known as "gill trouble." As yet the work is in the early experimental stage, but I feel much encouraged as to the treatment developing into an important factor in the propagation of brook trout. Fish, like the human family, are subject to disease. The most common in the trout family is the above mentioned gill trouble. If unchecked the death rate among the confined fish is enormous. Scientists and fish culturists have spent years of study to find some method of checking the disease in the early stages. The pioneers in trout culture discovered that bathing the fish in a strong salt brine would, to some extent, check the ravages of gill trouble and to the present writing this is still considered the most beneficial remedy.

At the meeting held in Sturgeon Bay, Capt. Albert Kalmbach, who was born on the shores of Lake Michigan and who has been a commercial fisherman for some 45 years, read a paper to the fishermen present. The sentiment and ideas expressed by Capt. Kalmbach are so absolutely true and parallel with the conservation ideas of this commission that I take a great pleasure in printing his paper in this report.

THE EFFECT OF GASOLINE AND BENZINE ON THE PARASITIC COPEPOD, SALMINCOLA EDWARDSII OLSSON, PARASITIC ON THE GILLS OF THE BROOK TROUT.

By JOHN N. LOWE.

On or about July 8, 1916, Mr. James Nevin, Chairman of the Conservation Commission, requested me to perform experiments with gasoline with a view of determining whether it would destroy the parasitic copepod (Salmincola edwardsii Olsson) which is parasitic on the gills of the brook trout (Salvelinus fontinalis).

Three hatcheries were visited during the investigation, viz. Madison, Wild Rose and Bayfield.

The hatchery at Wild Rose presented the most extensive infection, the adult trout being most affected, but the young fish (fry) were found to be infested with one or more parasites. At Madison the adult fish were not as extensively infected as at Wild Rose but the condition was serious. The young fish (fry and year old) were found to be entirely free from the parasite. The young fish are kept in ponds which are entirely free from all sources of contamination. The Bayfield hatchery presented a different problem and has conditions which are more difficult to overcome. The water coming from Pike's creek is a constant source of infection as it was found that the "wild" trout were infected by the parasite. Nevertheless, it was found upon examination of the fish that the percentage of fish attacked by the parasite was less than at Wild Rose.

The experiments were performed at the Madison and Wild Rose hatcheries. The fish were exposed to gasoline and benzine for varying periods of time. A stop watch was used for recording time. The copepods were examined with a pocket lens magnifying 14 diameters, or with the lower power (⅔) of a compound microscope.

The fish placed in gasoline or benzine did not show any discomfort for the first fifteen or thirty seconds. After this period they jumped a great deal and gasped. In about two or three minutes they were suffocated or nearly so. The mucus secreted by the glands covered the entire body. It was creamy white due to the coagulation.

The recovery of the fish was interesting in these experiments. The gaoline penetrated into the tissues of the fish. The gills were covered with an oily film, which inhibited the respiratory functions of the fish and its recovery for a short time. When the fish were returned from gasoline to water, they remained on their sides from five to twenty-five minutes, depending upon the length of time they were kept in the gasoline and benzine. There was a spasmodic gasping for a while (3 to 40 or more minutes), when the fish would make an uncoördinated dash forward, the distance covered varying with the individual fish. The usual distance was from two to four feet, when they fell on their sides. After a rest of two or three minutes another start would be made. After this period of rest the fish would right themselves and swim about in a more or less coördinated manner and finally recover.

Benzine was tried because it has a greater evaporating power than gasoline. It was found that fish treated with benzine recovered more rapidly than those treated with gasoline.

The fish treated with gasoline, benzine, or a mixture of the two were apt to die after partial or complete recovery. The muscles in the tail region would begin to stiffen and slowly all the muscles of the body became involved. The heart continued to beat from three to four hours after the muscles of the body had stiffened. The parasites examined on a fish in this condition were found to be in a healthy condition, and continued to live for hours after the fish were dead.

Most of the fish that were exposed to gasoline, benzine, or mixtures of the two, from one to five minutes recovered completely. The fish that died were individuals which were heavily parasitized or had been weakened by the parasites some time previously. There were a very few fish that lived after a six to ten minute exposure.

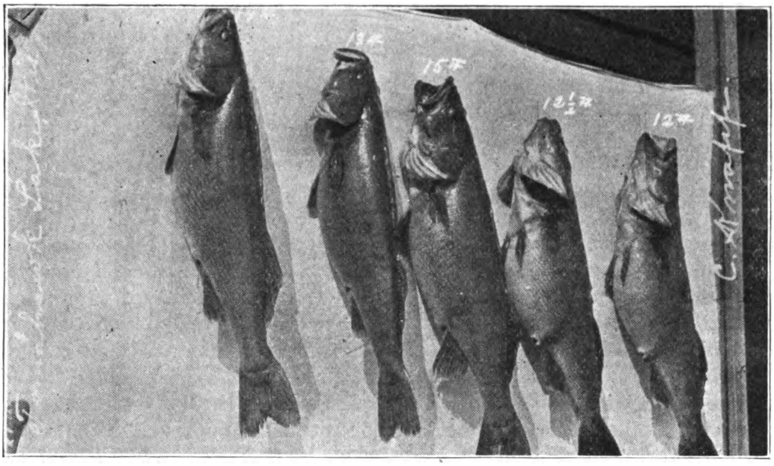
In regard to the effect of gasoline and benzine on the copepod, it is clear from a study of the experiments listed, that the parasite can withstand the effects of gasoline and benzine for a longer period than any of the brook trout can, even those in the best condition. Very few brook trout can live in gasoline or benzine more than ten minutes, but the parasites live in them from seventeen to twenty-eight minutes. A few of the copepods die when exposed to gasoline or benzine from three to ten minutes, but the number affected is so small that for all practical purposes the results are negative. Careful examination of the parasites killed by gasoline or benzine showed them to be very young individuals or females that had shed their first or second batch of eggs. Probably the ruptured egg sacs permit the gasoline to penetrate into the vitals of the copepod. The vigorous females with their first egg sacs developing are not killed by gasoline or benzine.

The life cycle of the female copepod is about three months. After this period death ensues and the dead parasite and the affected gill undergo deterioration. This reduces the number of functioning gill filaments, and the respiratory functions of the fish. The dead copepod and the affected gill filament serve as a locus for bacterial and fungus infections. Many of the fish examined had no paraistes on their gills, but from the white color of the degenerated gill filaments showed conclusively that they had been heavily infected. It was fish in this condition that died first, even a three minute exposure to gasoline or benzine causing death.

The affected gill filament appears white in color and is very firm to touch. This hardness is probably due to the formation of the scar tissue. The whiteness of the gill filaments is caused by the destruction of the very fine capillaries of the gill filaments. With this impoverished circulation and respiration the vitality of the fish is very much reduced.

The fish having a large number of white and hard gill filaments were found to be in very poor physical condition. There was no fat on the intestine or body wall. The fish were lean and the muscles were firm. The fish that had not been affected by the parasites showed the intestines surrounded with fat and the body cavity was lined with a thin layer of fat. The muscles had a firmness characteristic of fish in prime condition. This observation has an economic bearing.

It is a known fact that fish in nature put on extra amount of fat before their spawning season. This reserve of fat is used up during the maturation of the ova. Therefore, the number and quality of eggs produced by the individual fish is dependent upon its physical condition. The high death rate of infected fish during or after the spawning season is no doubt due to the weakened condition of the fish by the parasite. The constant handling of the fish during this period is also a contributory cause as the weaker fish are not able to withstand the stripping.



FOUR WALL-EYED PIKE. TOTAL WEIGHT 66½ POUNDS. TAKEN FROM TOMAHAWK LAKE, ONEIDA COUNTY, WISCONSIN

The parasites are more numerous upon the old fish. A few parasites are harmful to the fish. Even a single parasite withdraws from the trout just enough blood for its own sustenance. The amount of blood required may be small but it is a loss, and it weakens the fish by just so much, and if the parasite dies this gill filament is functionless. When we consider that there are found from 125 to 200 copepods on the gills of a single fish we are forced to conclude that the drain on the fish's vitality is enormous. With this constant drain there is no energy left for the production of eggs.

THE USE OF GASOLINE IN THE TREATMENT OF FIN TROUBLE AMONG BROOK TROUT.

By R. L. RIPPLE.

During the month of April at the Bayfield Hatchery, there developed a certain fin trouble or disease among several thousand of our brook trout yearlings, a disease with which all fish culturists have come in contact with more or less. The quarters and conditions under which these particular trout were kept and had wintered were ideal, except that the space was somewhat limited and perhaps a little crowded. This fin trouble or disease, if it should be called such, was, in my opinion, caused in some way owing to said close quarters. Many thousands of trout of same age and size, from same eggs and stock fish, were wintered in the same water conditions, but with more ample space and with no bad results, and are a grand lot of trout at this time. When this fin trouble was first noticed, the very tips of the different fins, and tail as well, were slightly frayed, reddish in color and inflamed, the dorsal fin being in all cases more badly affected as the trouble advanced. The trout, although in the above sore condition, never failed to eat and eat well up to the time they fell off and died. As stated above, the disease advanced more rapidly on the dorsal fin and when this fin became affected down to the body of the fish, that trout died. The strongest trout among this affected bunch seemed to throw off the disease and become little the worse for it, except that the dorsal fin would heal over and become only a short stub, the same being true also with other fins and tail. At the first realization of this trouble, I removed and started cleaning up all the affected fish by salt brining and changing quarters, but I soon found that the old method of salting trout was of no avail in this instance, but only hastened their death by keeping the soreness inflamed.

I had removed 500 or 600 of the very worst affected trout to one of the hatchery tanks to prove to myself whether or not the salting operations were really of no avail. Here the water could be drawn down at will and different amounts of water and salt brine strength were tried, but the trout fell off very rapidly. The disease had advanced at that time beyond where any salting or cleaning up by that method, either in weak or strong solution, would do any good. Several other things were tried and still the trout died. Any one who loves his work and that which falls under his personal care, as most hatchery men do, can appreciate the fact that there was nothing left undone in trying to save my little bunch of "speckled beauties." Commissioner Nevin visited the hatchery on Sunday at the time the disease was at its worst, and mentioned for me to try gasoline and kerosene on the fish, and see what effect that would have upon them.

The next day my good neighbor, Mr. Nourse, called me up saying that he wanted me to come over and help him make up a small crowd for an hour at his farm adjoining the hatchery, as one of University of Wisconsin men was to give a talk on the Diseases and Care of Sheep. I want to say here that I never will be sorry because of the one and one-half hours put in at that talk. The gentleman discribed the different diseases of sheep and finally came to stomach trouble and stomach worms and stated in his remarks that 2 spoonfuls of gasoline to 3 ounces of fresh cows' milk would cure and rid the sheep of worms. In my desperation in trying to do for my bunch of trout, I thought if gasoline had a killing effect on the stomach worms in sheep, why not might its uses be applied to this fin disease of my trout, as I had, of course, supposed that the fin trouble was a germ or parasite of some kind. It did not take me long to collect a half dozen of my worst affected yearling trout and place them in a quart of pure gasoline. In one minute by the watch all were quiet; the struggling of the trout was over; two more minutes elapsed, at which time they were removed to a vat of running water. After watching them several minutes without a quiver anywhere, feeling sorry, giving them up as dead and intending trying another lot for a shorter period of time in the gasoline, I was called out on the pounds. In about 15 minutes upon my return to the hatchery, I discovered my treated trout swiming about gaily. To test their welfare, I gave them some nice fresh liver to humbly atone for the trick I had served them. To my surprise they took food readily. To my further surprise, as I happened to glance into the gasoline measure in which they had been treated, I found that the gasoline was of dirty brownish color and jelly-like, and this proved to me that something had come off those trout.

The treated fish fairly glistened in coloring, they were so clean. The frayed fins turned whitish color at the diseased ends. It was not long before I treated quite a number in like manner, and kept two tanks going, one with the gasoline treated fish, and the other tank containing the salt brined trout. There was a loss in both tanks, but much greater by far in the salted tank. As I was treating my worst cases in both instances, there was bound to be a death loss among the gasoline treated trout from those fish that were beyond any hope anyway.

My experiments told me as far as I carried them that there is something to gasoline in the treatment and cleaning up of trout that should be carried out in a more scientific manner. Three minutes is the limit of time which brook trout will stand the clear gasoline, and revive in running water. The final loss of this bunch of trout was about one-half. Of those treated with gasoline, many were no doubt beyond any help at that time.

Without more positive proof on my part, owing to absence of strong magnifying glasses, and proper amount of time to devote to the work, and the advanced stage of the disease when the gasoline treatment was begun, I cannot state just what results were obtained. At any rate, here is something worth further consideration in the cleaning up of trout, and in the treatment of fin trouble herein referred to, especially if started when the fin trouble is in the first stages.

WHITE BASS TAKEN FROM THE WOLF RIVER, WISCONSIN

I cannot help but think what a great means this gasoline treatment might become if properly applied in the case of the common fish louse or copepod, which attaches itself to the gills of the brook trout, as many of you know. If only to destroy the two protruding egg sacs of this eventually death dealing parasite, that alone would pay well for an occasional gasoline bath among affected brook trout. Thousands of brook trout of any size may be treated in a few gallons of gasoline by holding them in it with scap nets.

PAPER READ AT MEETING HELD WITH COMMERCIAL FISHERMEN AT STURGEON BAY, WISCONSIN, FEBRUARY 16, 1916.

By ALBERT KALMBACH.

I am glad another opportunity is given us to meet at this time and discuss our common interests. In a spirit of good will to all, I have a message for you. It lies close to my heart and in choosing my thoughts I assure you I have only the future welfare of you fishermen in mind.

You all know I have about lived my alloted time in this career. My life is nearly spent. I have spent it among the fishermen. Personally I cannot live long enough to get much benefit out of conservation of fish, but sincerely, boys, I want you to think, and think hard and fast, I want to give you the benefit of my many years' experience in producing and marketing fish and studious observation of fish culture, and if by my humble efforts I can help make your future conditions better, then I can feel I am doing something in turn for good that has come to me in the business.

We are face to face with conditions that cannot continue as they are. Let us take our lessons from the experience of the past, and correct the future, making it much better for ourselves and our children.

This county is most favorably situated for fishermen, except possibly the marketing or selling of fish.

Our waters offer a considerable variety of edible fish. It has wonderful feeding and spawning grounds for all of them. The waters of Green Bay in particular offer one of the grandest opportunities for fish culture that the sun shines on. I believe and know that to be so.

If we could picture the real truth of our advantage until all the fishermen would have a state of mind that would make of each a volunteer defender of our future business; if they would look on our waters as the source of their future living, and they would honestly and earnestly work to guard that treasure as they would their bank account, they would earn very much more money, do it easier, feel better, take a livelier interest in public matters and become a most honored citizen, one in whom the whole community would take pride.

In arranging these meetings, we feel it is for the future good of our business that we promote a better understanding of each other and through such understanding become interested in the things that go to make our profession in life one of common sympathies.

We are composed of pound net, gill net and hook fishermen. But let us forget we are pound net men, or gill net men or hook men. Let us think of a larger meaning of the word fisherman, and in this spirit we are men, earning an honorable living by producing food for the people, just as honorable as farming, and let us put honor into the profession. In these waters and this profession we have the means of making men, men we can be proud of as citizens.

In becoming fishermen in the larger meaning of the word, let us coöperate with one another, for getting our selfish ideas such as arise in differing interests as pound net men, and gill net men and hook men. Let us all help each other, aim to get legislation that will get us more fish in years to come.

It does not take much of an observer to see we are playing a losing game. A bare living or existence, with no gain, is the fare of most of the boys. What does that experience teach us? It means there is something very wrong, either in the way we catch fish or stock the waters, or both. You have all seen tons and tons of immature fish caught. If a total of those figures would confront you today you could scarcely believe your senses. Suppose for instance ten or fifteen years ago we had all sat around a good-fellowship club, had a good banquet and all had that Christmas felling such as we have for our families, and the idea went around the room, what can I do for each one of you? If you get each member of your family something for Christmas it costs you something. Now we want to do something for one another that costs an effort and sacrifice, and someone suggests,—We will not catch any more immature fish,—what do you suppose would have been the result today if such a suggestion were carried out? Here is a conservative estimate. Take one thousand pounds of No. 2 trout at a market price of three cents or thirty dollars. That is the value the fisherman gets, and the end, the end, mind you, of that thousand pounds. No other results from it to the fisherman.

You leave those fish alone as this Christmas gift to one another and what happens?

Let them grow to be four or six pounders and they become four thousand pounds, and at an average price of 7½ cents and their value is what? $300.00 or ten times as much as the 1000 pounds of immature. What else do we get by leaving them a few years? These fish on maturing will spawn and reproduce. A conservative estimate, you will agree with me would be several hundred thousand eggs from this 4000 pounds of mature fish. Most of the eggs in its turn becoming, in time, a fish, and by reason of this Christmas spirit we will let the fish grow to maturity, and it in turn leaves thousands of eggs behind it. Just pencil this out and the results will stagger the most vivid imagination among you. And mind you, we started with one thousand pounds of immature fish as a gift to each other. A small guess in eggs would be ten times as many fish reproduced, and put to dollars and cents becomes $3,000.00. That would have been a wonderful Christmas gift for us boys, now wouldn't it? To make that much for us now, we sacrificed back there a few years ago, $30.00 of fish for such wonderful results. Multiply such results many, many times for we have caught and marketed hundreds of tons of immature fish.

What would you think of a farmer who took crop after crop off his soil and never put anything back on the farm? He would be committing business suicide. And suppose that farmer couldn't wait for his stock to grow to maturity and good prices, but would slaughter the little pigs, the calves, the colts and the wee chickens for a few cents because it was quick money and he could not wait. Would you say he was a good candidate for the foolish house?

That is a parallel I am impelled to draw in order that I may impress on your minds the necessity of changing our ways of business suicide. That is the viewpoint I want to place before you. I have not overstated the figures. I have understated them.

If we were big coöperative brothers, helping one another, and some ten to fifteen years ago adopted this Christmas spirit toward one another would we be scratching our heads and wondering how soon the finishing touches will be put to our business?

INTERIOR VIEW STATE HATCHERY AT OSHKOSH
HATCHING PIKE EGGS

The great State of Wisconsin has upon its statute books many laws aimed at helping us fishermen. This department of laws has made mistakes due to the fact that the makers of the laws did not know our conditions nor our possibilities. Particularly our possibilities. We had no means of becoming closely associated, most of our fishermen looked upon these laws and their officers as an institution interfering with their rights as individuals.

Selfish ideas for easy money over-balances the great constructive game, that of making a profession based upon fundamental principles of continuous existence and prosperity. Let us try to get legislation based on practical ideas that mean the building up of the industry. Then let us feel these laws are for us. You and me. Our future benefit. And we find ourselves in a spirit of coöperation with these laws. We and our interests are bound up with them, and when we see that, we become men in the large sense, men who feel today's acts are tomorrow's results.

The state is going a long way to meet us and putting out the correct idea, of serving our real needs just like mothering a family. Her representatives are with us today in a true spirit of "getting together," and aiming to make our future better. Suppose every commercial fisherman would accept with his privilege of fishing some responsibility to place back in the water something for what he has taken out, that would cost him some sacrifice and effort, and if he made this sacrifice he would feel some future interest in the waters and set forces to work to protect his future interests.

Our present method of grabbing what we can out of the water, because everybody is doing it, is what has brought us to our present crisis. We are now paying for that thoughtless way.

We read a few years ago that down East were thousands of abandoned farms, run out of business by their former owners, and left for taxes.

Someone with brains comes along, puts an effort and sacrifice onto the farm, regenerates the place, and it again becomes habitable and productive. So, with our waters, we have them run down to a point where it is a struggle to exist, in fact, our continued existence in this business is going to compel us to do something sooner or later. We have the waters to build up the industry, now, let us become coöperators using good business judgment. I want to call your attention, in closing, to what has been done in places where they have had the same troubles that now confront us.

Lake Erie was run down in fish stock. Boats could not pay expenses. There were no white fish and herring were very scarce. They went to a three-inch mesh net for small size and a four and one-half inch mesh for white fish. Everybody was loyal in support of those sizes. Last spring one boat on Lake Erie caught eleven thousand dollars of white fish in two months. When the fall run of herring came on, eighty-five tugs from seventy to ninety feet long each, fished out of Erie, Penn., and Dunkirk, New York, with daily catches ranging from two to ten tons each, and receiving four cents per pound in the round, for this stock, and on Lake Erie there are about 200 steam tugs. Some of them catch three hundred and fifty tons of fish per annum. On Lake Michigan and Green Bay we have about ninety steam tugs, in Michigan and Wisconsin. We have a very large body of water and a great deal of fine grounds for fish culture, and we could stock these waters to such an extent as to make us all rich.

But, the size of the catches is by no means the whole story. Go into the market at Chicago and see the prices Lake Erie fish bring. Compare their prices to the prices that our stock brings. It would pay all of you to spend some money to see these things for yourself, then you would know the truth on this subject.

We are men, and I believe in you, have known most all of you many years. I want to see you all do better, and so I urge now and here that we get better laws and become, ourselves, a part of those laws, realizing they are for us. Let us make the catching, marketing and shipping of immature fish an impossibility. We will then raise our profession in the eyes of all the world. Each one of us become a conservation force, active and alive, and no one will violate the spirit or rules of the game.

Loading Fish Car Badger No 2
At Woodruff Wis with Pike Fry May 30-1916

LOADING STATE DISTRIBUTION CAR AT WOODRUFF, WISCONSIN. DISTRIBUTING PIKE FRY

DIVISION OF WILD LIFE CONSERVATION

By W. E. BARBER.

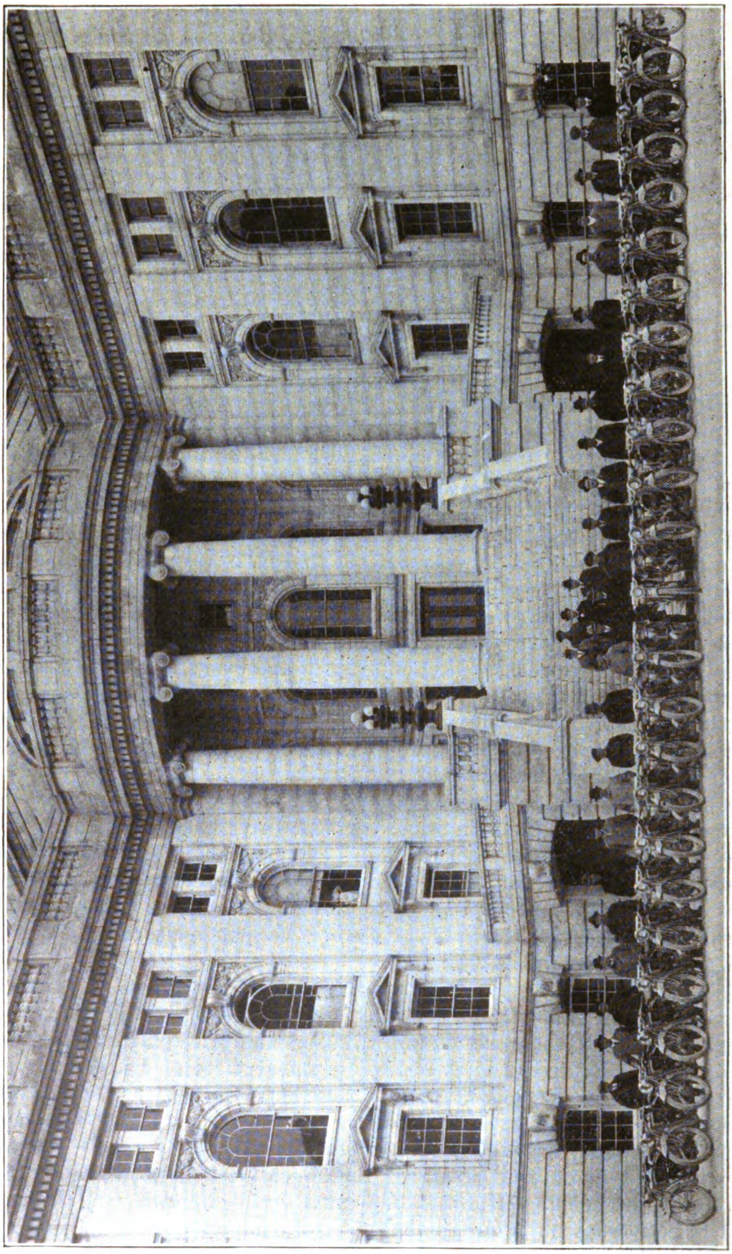
CONSERVATION WARDENS.

The first year of the supervision of this division by the Conservation Commission closed June 30, 1916, and we beg to report that much has been accomplished in the reorganization of the warden department for greater efficiency, in weeding out the dead timber and placing every warden on his merits of efficiency to retain his position with this division.

Wardens have been advised that circumspection in their deportment was demanded in all of their official acts and that their duties were to be confined entirely to the conserving of the wild life of the state, and that their political activities would no longer be the measure of their tenure in office. This departure has resulted in a more coherent organization which is manifest in a more general interest by each and every warden in pushing forward the activities of this division. We shall endeavor to add strength to this division by carrying forward the policy we have established and enthusing the spirit of coöperation among our force, which must result in greater accomplishments in the future.

The consolidation of these various departments has promoted the efficiency of the warden division tremendously. The permanent employes of the various departments are all conservation wardens with police powers to make arrests for any violations of the conservation laws, giving this division added supervision in suppressing violations. Besides, the parks and forests are essential for game covers and naturally belong in the great scheme of conservation.

We have in all at the present time 76 conservation wardens. This number is made up of 63 engaged entirely in the activities of wild life patrol duties. Added to these are ten forest rangers and three park superintendents who are located in vicinities where the services of wardens are essential. Prior to the consolidation of these departments, the wide stretch of wild timberlands of the northern part of the state were without adequate protection, and the adding of the forest rangers to the warden division had given that territory the much needed protection. The park superintendents perform an important service in protecting the song and insectiverous birds during the influx of campers during the summer months. They also patrol a considerable additional territory during the winter months.



MOTORCYCLE SQUAD, WISCONSIN CONSERVATION WARDENS

EQUIPMENT.

After taking an inventory of the equipment for carrying on the warden service we found that much was lacking in the facilities for wardens in covering their respective territories. Eight of the wardens owned automobiles which they were using under a per diem system. Two owned horses and were receiving pay in like manner. The balance had no way of covering their territory except as they hired livery, travelled by train or on foot. After auditing the expense accounts for a few months, we found that a large part of their expense accounts were for transportation, and they were by no means covering their territories adequately. It was up to us to furnish some means of transportation for our men if we were to expect efficient service. We informed ourselves as to what other states were doing for equipment and found them all in about the same condition as we were. We did find, however, that Massachusetts was using motorcycles in its forestry department for its rangers. They reported to us that they were a great success in both efficiency and economy. After gathering all of the information available, we concluded to purchase either motorcycles or Ford cars, and proceeded to advertise for bids for furnishing 25 motorcycles. We took the matter up with the Ford people and they sent their field man to Madison to confer with us. His best offer was their list price, as he said under the company's rules, they were obliged to protect their agents and could not make an inside price even if we took 25 cars.

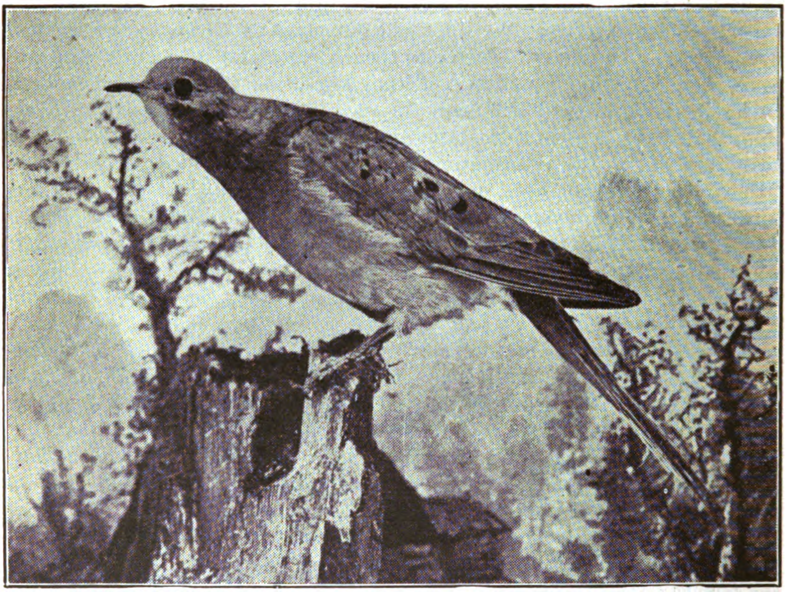
Our best bid for 25 motorcycles was $4,975, offered by the Excelsior Motorcycle Company, of Chicago. Our next best bid was $5,490, offered by the Harley-Davidson Motorcycle Company, of Milwaukee. One other bid was offered by the Indian Motorcycle Company, of Springfield, Mass., their bid being $5,668.75. We placed our order with the Excelsior people, as they were the lowest bidders and offered a machine equal to any of the others, as pronounced by motorcycle experts. We put these motorcycles in use on May 20 of this year, and we believe they have paid their cost in saving of expenses. Besides, they have materially facilitated the service. Our contract with the Excelsior people covers the overhauling of every machine this winter, putting on new tires, reënamelling, overhauling the engine, replacing all worn parts with new and making the machines as nearly as possible as good as new. The price for this overhauling is $30 for each machine.

Wardens who own automobiles we are allowing five cents per mile for the miles actually travelled while in the service of the state. Automobiles are an expensive method of travel as compared with the motorcycle, but there is a large part of Wisconsin where motorcycles are not practical, as they are not a success on sandy roads.

We found the department lacking in sufficient boats to properly patrol the waters that come under our supervision, and have purchased six additional boats and Evinrude motors, and one large boat for lake patrol. We are still lacking in equipment for our wardens if we are to expect efficiency and we will add from time to time until this necessity is supplied. We believe that the State should own sufficient equipment for carrying on this work in an efficient manner without paying wardens for the use of equipment which they can ill afford to supply.

RUFFED GROUSE, PHEASANT AND PARTRIDGE.

Under the name of ruffed grouse, pheasant and partridge, this bird is well known to all sportsmen as the king of all game birds. It is not only the gamest of all game birds, but is the most palatable when served. This fine bird is in much need of protection or its name will be inscribed with those that have suffered extermination. Not many years ago these birds were plentiful in Wisconsin, inhabiting every grove and woodland throughout the state, and no thought was given to their protection until their scattered numbers gave warning to the sportsmen that something must be done.



MOURNING DOVE

It was then that the first remedial law was passed, and that simply prescribed a shorter open season for hunting them and a reduced bag limit. The law protecting these birds is so promiscuously localized that a hunter travelling through three counties will find the same number of different laws. In other words, there are too many laws that apply only to separate counties.

It was a mistake that the last legislature did not prescribe a closed season for partridge, for the past two seasons have been disastrous in that the sleet, rain and ice during the winter months covered the forage, destroying many of them. The cold rainy weather during the hatching season lessened the hatch of young birds. In the face of these facts it is no wonder that word comes to us from every part of the state that partridge are very scarce and in some localities that there are none at all. The only thing that will save this specie is a closed season, and it should extend until 1920.

PRAIRIE CHICKEN.

We can only repeat the same story of the prairie chicken that we have recited of the partridge. They are "on their last legs" and must receive attention from this legislature. Scattered flocks of small numbers are seen in some sections of the state, but from many counties the report comes to us that not a single bird is seen. This is a melancholy story as compared to those of a few years ago when they were seen in every county of the state in large flocks, furnishing the most exhilerating sport for both sportsmen and dog, and offering a resistless opportunity to enjoy the great outdoors.

There is a danger line in the resistless law of nature governing these species below which we must not trespass or we invite inevitable extermination. It is conceded by all ornithologists that there is a diverging line below which bird life cannot survive their natural enemies, and a lingering thinning of their numbers by these pests eventually results in their extermination. We are not too sure that our prairie chicken have not approached this line and we submit this information to this legislature to enable it to pass such laws as in its best judgment will conserve this specie. We advise a closed season until 1920.

QUAIL.

Quail are coming back. That sounds good and is full of meaning for these birds were so nearly exterminated in Wisconsin that after 22 years of continuous closed season they are just beginning to recover in appreciable numbers. We believe that at the expiration of the closed season which extends until 1921 we will have them in sufficient numbers to provide short open seasons for taking them. Many of the New England states have lost their quail and despite their efforts to bring them back by the importation of breeding stock, they have accomplished nothing as yet. It is the same story the world over that when you once let your native birds get away, it seems a matter of impossibility to restore them. There has been no degree of success attained by any of the states in the artificial propagation of our native birds. The only safe system is to watch carefully and protect them in their natural habitations.

The last two winters were exceedingly severe, as the heavy sleet and rain storms formed a coating of ice, covering the food supply, and immediately following we were visited with heavy falls of snow accompanied with severe cold weather. It was only through heroic work by this department that tremendous losses of these birds was averted. Feed was supplied by the state and the various protective associations, which was distributed by our wardens and members of the associations, and the birds survived with very few perishing.

The farmers generally are very choice of the covies that are located on their premises, as they have proven their value to the agriculturist in destroying potato bugs and other destructive insects. Consequently the quail have a generous friend in the farmer and a thrifty spirit of coöperation is redounding greatly to the benefit of the quail.

BOB WHITE

DUCKS.

We view with optimism the future of all of our waterfowl. The Federal Migratory Bird law has thrown around them that degree of protection that in its scope guarantees their protection throughout the United States. The few years that this law has been in effect has proven the wisdom of its passage in a large increase in the number of birds coming to Wisconsin. Our wardens report that it has been many years since the influx of birds has been as great as this year, and many are making the lake regions of the northern part of the state their nesting grounds. Since the enactment of the proper kind of state and Federal laws for their protection, there has been noted everywhere a marked increase compared to the decline noted when unregulated hunting was allowed.

In our judgment it should not be the purpose of any restrictive law to make it so unreasonable as to preclude the possibility of the sportsmen bagging a legitimate limit. And in discussing this question we do not want to be understood as favoring a law that will open up the way for wholesale slaughter, but we do believe that the present law restricting the hours to a "sunrise and sunset" schedule is drawing the line a little too close. In our judgment this law could be extended to 20 minutes before sunrise and 20 minutes after sunset without infringing upon the safety in proper protection. Our very best sportsmen who are as strongly in favor of proper protection as any member of this commission and who are giving us most valuable assistance in the enforcement of the game laws, contend that our present law is too restrictive and should be changed as suggested above.

Wood duck are responding to the closed season provided for them six years ago and are coming back in large numbers. Our wardens report large flocks of them in every part of the state where a few years ago they were seldom seen. Mallards, teal, canvasbacks, redhead, pintail and coots are found in large numbers throughout the watered districts of the state.

So we feel safe in saying that our waterfowl are on the increase and they will continue to be a great source of pleasure and profit to all that enjoy the sport of hunting.

GEESE.

Geese have never been considered much of an asset to the sportsmen of Wisconsin. This is easily accounted for, as geese only light in a wide open space of country where their vision is not restricted. Their instinct of avoiding danger is much more keen than that of the other species. They adhere assiduously to nature's warning that self preservation is the first law of nature, and they take no chances. The only places in Wisconsin where any shooting of geese is reported is in Jefferson, Dane, Rock and Walworth counties. They frequently, while on their flight south, light in the open fields of these counties and some of our sportsmen usually wait their coming and occasionally bag a few of them; but these instances are rare.

THE FEDERAL MIGRATORY BIRD LAW.

The Federal Migratory Bird law which directs the Department of Agriculture to adopt suitable regulations and prescribe a fixed open and closed season for migratory birds has done more to conserve the migratory birds than all the laws ever passed by any of the states since the necessity for passing protective game laws was conceived. The game laws which were passed at the last session of our legislature were framed to conform to the Federal law and it has added tremendously to the power and efficiency of our laws. It has not entirely done away with violations, but it has reduced all flagrant violations to the minimum. The Department is now considering the adoption of a Federal bag limit and the prohibiting of the sale of migratory waterfowl. This regulation would add another strong arm to the law which would aid tremendously. The Federal game laws have done more to bring protective legislation in the southern states than any other one thing.

Before the passing of that law, half of the southern states made no pretense at game protection, but now the states are few that haven't a very substantial code of laws which in most of the states are fairly well enforced. The prevailing weakness of the laws in those states is that they allow the sale of game, thus opening the way for wholesale slaughter. Their bag limits are excessive and they show no disposition to economize in saving the birds. Until this last year, their bag limit was 50 birds, but so much pressure was brought to bear by other states in urging that their bag limit was unfair to the more progressive states of the north, that they reduced it to 25 birds.

At the National Association of the Game and Fish Commissioners held at New Orleans the week of October 10, 1916, strong pressure was brought to bear urging that the states adopt a uniform bag limit for migratory birds, giving each state an equal maximum opportunity to share in the spoils of this natural resource. But no agreement was reached. However, we believe that such a resolution will be adopted at our next meeting which is to be held in St. Paul next year. Our sportsmen have claimed for years that we have not been getting a square deal or an equal opportunity with the southern states in taking these birds. We have claimed that we were protecting them rigidly during their stay in the north, carefully protecting them through the breeding season, only to have them slaughtered in the wintering zone in the south. This is absolutely true, but we believe that at our next annual meeting at St. Paul, this condition will be remedied and we will get together on a uniform bag limit and restrict all sale of these birds, which will bring about the desired results.

THE FEDERAL LACY LAW.

The Federal Lacy law which prohibits interstate shipment and traffic in game is a powerful weapon for good. This law applies only to states that have laws prohibiting the sale and traffic in game, and Wisconsin is one of that number. We have enforced the Wisconsin laws rigidly and have turned over to the Federal authorities several cases after receiving convictions in our courts. The Federal courts have then imposed additional fines, with heavy costs, which the violators have found a rough and rugged road to travel. It is important to know that one journey through the courts of this process has been sufficient to satisfy the game trafficker. We have never had occasion to make an arrest for a second offense, which convinces us that rigid laws is the true solution of game protection.

INSECTIVEROUS AND SONG BIRDS.

It is only within the past few years that any public attention was given to this class of birds. They came and went at their pleasure, and if they were fortunate enough to pass unmolested it was their good fortune. They were not looked upon as contributing anything of value to the human race other than their cheering songs and graceful presence about our daily walks. The hunter had no scruples as to shooting them just to see them fall prey to his marksmanship, and the small boy took delight in pursuing them with his toy implements of destruction. We are surprised that more of the species were not exterminated before modern education brought relief to these helpless creatures of the air.

TREE SPARROW

Reason and education has at last rescued them from the perils that pursued them continually and we have found that they are as indispensable to humanity as the sunshine and rain. We have found that without the birds, agriculture would be a lost industry and the green fields and foliage would disappear and a barren waste would follow in the wake of their destruction. No flowers would bloom or blossoms spring from the earth, but insects would swarm and vermin would cover the earth; and famine and desolation would be visited upon an ignorant and unholy race.

Our scientists have found that the value of these little creatures computed in dollars and cents alone amounts to millions of dollars annually. It is not beyond our reason to comprehend this when they have proven to us that many of the different varieties of insectiverous birds eat three times their weight in insects each day. Multiply this by the countless millions of these little workers that are busy from before sunrise until after sunset every day of the year, and contemplate what it means. It means that when we see one of these little creatures we must realize that he is a mighty creature for good to all humanity and that our lives depend upon his industry—that we must keep him forever with us.

The law protects these birds at all times and they are responding to this protection in increasing numbers. The Audubon societies have done a wonderful work in helping to create public sentiment favorable to bird life. Also in interesting the children in providing bird houses where they will be convenient for their nesting and in providing feeding stations where the birds find abundance of food during the winter months.

We still have a few alien inhabitants who have no regard for any species of wild life and they shoot or destroy the birds regardless of their usefulness. We are pleased to report, however, that the penalty of the law is easily inflicted on this class of violaters, as the courts are intolerant and invariably pronounce the extreme penalty of the law in these cases.

REFUGES AND SANCTUARIES.

The establishing of wild life refuges and sanctuaries has become a tremendous factor in the great scheme of conservation. Every state that has given consideration to the necessity of proper protection and maintaining of its species are establishing refuges where predatory animals and vermin are exterminated and every disturbing influence removed. Lured by the security and solitude offered by this sanctuary, the various species congregate with almost human intelligence and take up their home life.

States that have given the refuge system the longest tests are unanimous in their commendation of the beneficial results accomplished. Some states have set aside large tracts of wild lands, mostly timber lands, around which a single wire is strung to mark the boundary, and have placed posters short distances apart warning hunters and pedestrians that no firearms are allowed within the enclosure. The overflow from these refuges keeps the surrounding country supplied with the various species and guarantees a perpetual flow from these refuge districts for all time.

We have started this work in Wisconsin, having posted two community refuges, besides the six state parks, which are all patrolled by our wardens and careful attention given to the removing of disturbing elements. We are, however, handicapped through a lack of a proper refuge law to give these refuges the legal distinction they should have and the power to this commission necessary for state wide extension of this work. Our commission has framed a refuge law which we are submitting to this legislature for passage, which, if passed, will equip us to carry on this work in the manner it should be. The coming of the automobile has opened the remote districts where seclusion was found, and settlement is encroaching more and more upon their habitations. This condition demands that broader protection must be given for these creatures, which is best afforded by a generous supply of refuges.

DEER.

The immediate danger of exterminating our deer was overcome by the passage of the one buck law by our last legislature. This is a proven method of conservation. Sixteen other states have tried this method prior to the passage of the one buck law in Wisconsin. Something had to be done to save our deer, as settlements are fast encroaching on the wilderness and the fast increasing population is narrowing the area of their habitation. Consequently we must throw around them the necessary protection to retain them as an abundant game animal. In the light of experience, we know that no animal responds more readily to protection and encouragement than the deer, for our first year's trial of the one buck law has resulted in producing more fawns this year than have been seen in the deer territory in any previous year. Nothing is more reasonable if we exercise common sense, than that by retaining our female deer we will perpetuate the specie. The farmer, rearing his domestic cattle or other animals, keeps his females and sells off the males, thus providing against depletion of his herds. The one buck law is a common sense law and it needs no scientist or prophet to figure out the benefits that must surely follow its enforcement. Every sportsman who desires to leave to his posterity the inheritance that God ordained to the children of men will support this law with his very best efforts.

This law, we realize, is an inconvenience to the hunter who cares for nothing only to satisfy his desire to kill. He is angry when he sees the white tails bounding through the brush and he is obliged to restrain his passion to shoot until he can see the antlers. We admit there are hunters who will take the chance and shoot regardless of the consequences, but such men are not sportsmen. They belong to that class of hunters that should be denied a citizen's right to secure a license. We believe that a majority of our hunters are true sportsmen who are out for the sport, and their red blood demands the antlers.

To prove the efficiency of the one buck law to increase the supply of deer, we quote the experience that the state of Vermont has had with this law, it being the first state to adopt the law and consequently having had the longest experience:

> "Forty years ago, as a result of persistent hunting the deer were exterminated in the state of Vermont. In 1878 twenty sportsmen raised a fund and purchased from the Adirondack section of New York seventeen deer which were released in Turland and Bennington counties and protected by a closed season which continued for nineteen years. In 1897 an open season was again given, and has been continued each year since that

DEER IN STATE GAME FARM

time. During the eighteen years which have since elapsed bucks only have been killed, with the exception of the years 1909 and 1910 when an open season for does also was granted. This open season in 1909–10 was given solely for the reason that deer had become too plentiful and it was deemed wise to reduce their numbers.

"During these eighteen years official figures show that 23,265 deer have been killed by sportsmen. During the first half of the period, or from 1897 to 1905 inclusive, 2,855 deer were killed. During the second half 20,410 deer were killed, an increase of over 800 per cent. These figures prove * * * that under a buck law the deer increase in the woods at the same time that greater numbers are being taken by the hunters. The statement seems paradoxical, but there can be no denying the figures.

"It is interesting to note also that during the first four years of the open season, or from 1897 to 1900, inclusive, only 460 deer were killed, an average of 115 deer per year. This was the best that could be done after a nineteen year closed season. During the last six years the number taken averaged 2,763 deer per year. The great increase in Vermont deer therefore has taken place not under the protection afforded by a closed season, but under the buck law.

"Vermont, as stated before, is the state which has given the buck law the longest test. It is the only state in the Union today which complains with reason of having too many dear. In proportion to its hunting area more deer are killed under a buck law than in any other state under any kind of law. The deer are also the heaviest and finest specimens of the Virginia deer to be found in the United States. Hunting accidents are characteristically infrequent and the kind of accidents in which a man is shot at by mistake for a deer are almost unknown."

The one buck law has its friends and its foes—both equally pronounced in his praise and condemnation of the law, but viewing it from the standpoint of a conservation law, both as to humanity and deer, its first year's trial has demonstrated that it has conserved both. There was not a single fatality last winter from one hunter shooting another, mistaking him for a deer. A very unusual circumstance, for this is the first year in a score that several hunters have not lost their lives being shot to death by a reckless hunter that did not stop to see what he was shooting at. This law has demonstrated that the hunter stops and looks before he shoots. He looks for the horns, and does not shoot at the first sight of a moving object. It has made the hunter more cautious, and has added much to the sport for the hunter feels that his life is not in constant jeopardy. With all of the points favorable to this law, it should have but one amendment to make it complete. The law should specify that no deer may be taken without horns at least six inches long.

We refer those who believe that the one buck law is not a conservator of deer to the following schedule which shows the total number of deer shipped from the various counties during the years 1913, 1914 and 1915. This gives only the number of deer *shipped* and does not include those that were taken by private conveyances, which were many:

COUNTY	1913	1914	1915
Ashland	310	583	182
Barron	34	35	18
Bayfield	797	784	386
Brown	1	2	......
Burnett	32	1	2
Chippewa	167	201	118
Clark	85	86	34
Douglas	516	470	195
Dunn	24	17	......
Eau Claire	16	25	4
Florence	71	308	132
Forest	111	93	42
Iron	190	255	140
Jackson	26	16	7
Juneau	5	7	4
Langlade	75	104	39
Lincoln	101	147	39
Marathon	14	26	5
Marinette	195	205	76
Monroe	2	5	3
Oconto	20	58	31
Oneida	629	577	258
Polk	22	18	9
Price	487	529	145
Portage	1	2	.. ...
Rusk	508	368	185
Sawyer	968	1074	502
Shawano	7	4	4
Taylor	599	667	255
Trempealeau	......	1	......
Vilas	657	284	178
Washburn	232	184	178
Michigan points	......	29	32
Unidentified, picked up by expressmen	67	59	54
Total	6969	7373	3137

THE MARKET HUNTERS.

It is needless to say that the market and pot hunters care little about the law as it now stands. They figure that there is only one chance in ten of their being caught, and if they are caught, the penalty of from $5 to $25 is only the fruit of one day's hunt; and they are willing to take the chance. These are the men that are the real destroyers of our game.

BEAR HUNTERS IN NORTHERN WISCONSIN

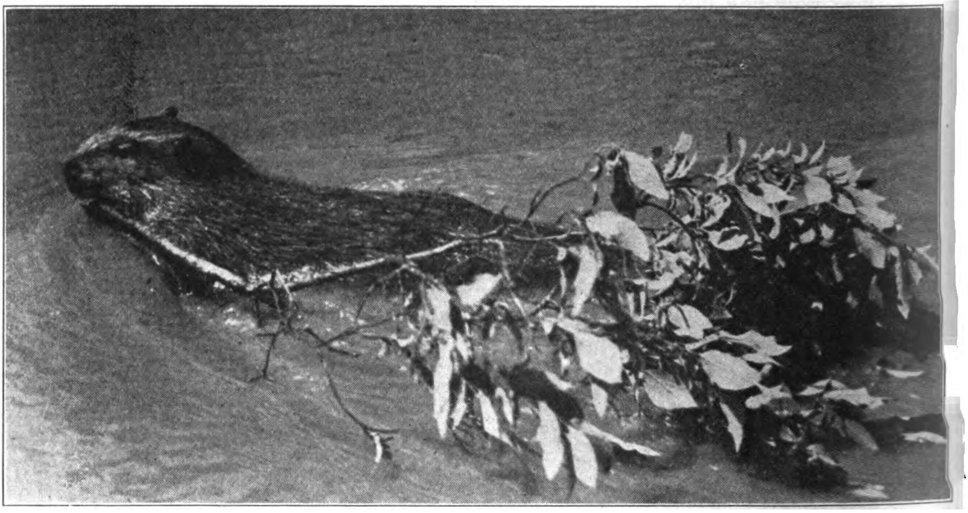
There is but one way to stop the traffic in game and that is by a heavy fine, and imprisonment for the second offense. The Federal Lacy law which prohibits interstate shipments of game has had a deterrent effect in shipping game outside of the state. The market hunter takes a long chance in undertaking to ship game to Chicago or any of the large markets, and but few have been willing to take that chance of falling into the clutches of Uncle Sam. Uncle Sam's laws are stringent and they fear them —they are afraid of the $200 fine—but they have no difficulty in peddling game to willing purchasers near home. For instance, it is a notorious fact that the market hunter enjoys a lucrative business in trafficking in deer during the entire year. They do not wait until the opening of the deer hunting season, November 11, but they start out and secure a supply and have it ready for the hunters when they arrive. The hunter who is not fortunate enough after a week or ten days hunting to get his stipulated one buck, can easily (if so disposed) purchase one from the wiley market hunter and take his trophy home. This is a common practice, and while we are able to arrest an occasional market hunter, the fine is so small that it makes but a small dent in his lucrative profits.

For instance, last winter we found where one of these market hunters had six deer hidden. We watched until he came after them and arrested him, took him into court where he plead guilty and was fined $50, the maximum for this violation. We sold the deer in Milwaukee for about $200. It is an inviting occupation for a good hunter and it is no wonder that they hazard the chance. The fine should be $100 for killing a deer out of season and $100 fine for each deer or part thereof sold, or six months in jail. Such a law would put a stop to the slaughter of deer for the markets and save them for the legitimate hunter.

From the mass of evidence we have, we feel safe in saying that one-half of all of the deer killed are killed by these market hunters. Their field for operation is so vast and their opportunity for evading an officer so extensive that it is hard to catch them. Besides, they are a lawless, desperate class of men and the law-abiding citizens are afraid to report them as they would be endangering their lives and property. Instances have been known where mysterious burning of buildings could be traced to this provocation. So we ask this legislature to arm us with some good stringent laws, backed up with rigid fines, and we feel confident we can suppress this vicious practice.

BEAVER.

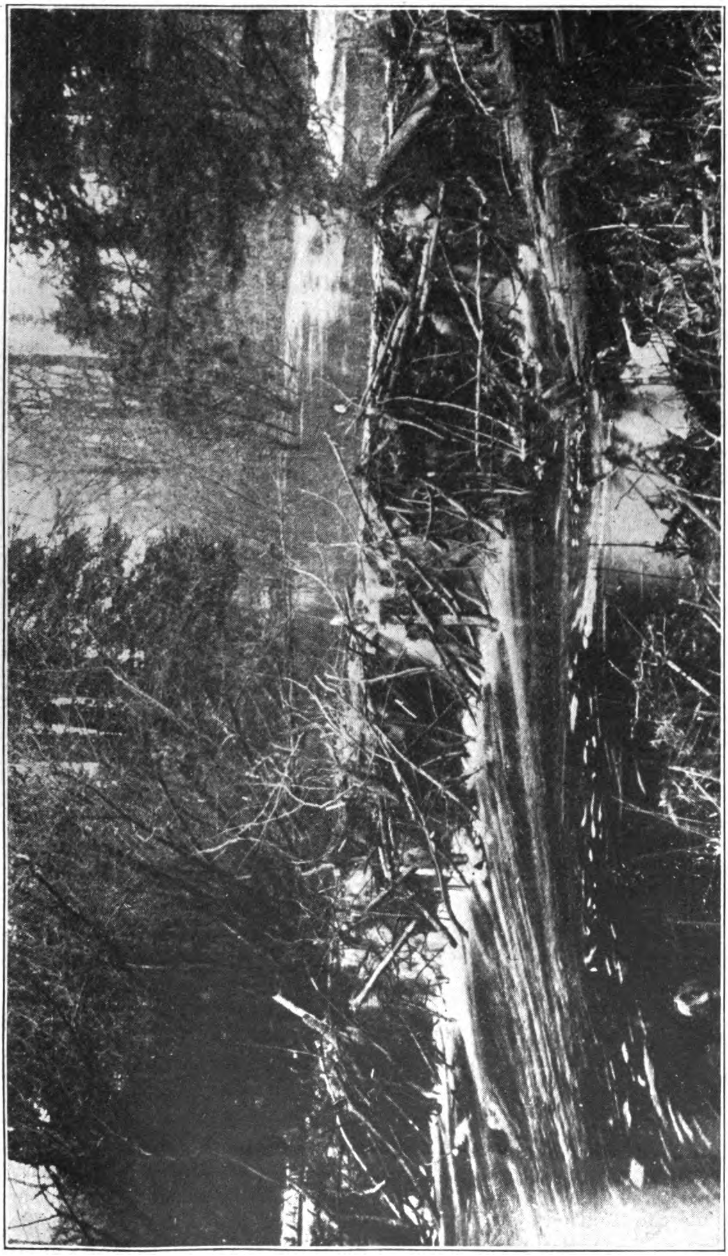
In discussing the beaver situation in Wisconsin, we believe we have a sufficient fund of information on the life and customs of these little animals to write a book. There is no part of our duties that have been beset with so much difficulty as the wise little beaver have caused. He possesses more wisdom and is the master of more trades than the combined intelligence of all the animal kingdom. He is a forester, a lumberman, an architect, a carpenter, a mason and an all-round genius. He builds his dam and house and takes up his abode where he sees fit, regardless of all human consideration, backing up the water, covering cultivated fields and meadows much to the annoyance of the farmer. He backs up the water flooding railroad tracks and interferes with the commerce of the commonwealth, and no man dares molest his well laid plans to provide for themselves and families, for he is wrapped in the plainly written laws of the state of Wisconsin, which expressly provide that "no person shall hunt, take, capture or kill any beaver or molest their houses or dams." Protected as he is and has been for the past ten years, their numbers have multiplied until they have become a nuisance all through the northern part of the state. Their numbers have become so great and they multiply so rapidly that they will soon hold title to a large portion of some of the counties by right of preëmption of claim. Scarcely a day passes that our commission does not get a complaint that a beaver colony has dammed a stream and asking us to relieve the situation. We, immediately upon getting a complaint, dispatch one of our wardens to blow out the dam and destroy the houses, only to have the satisfaction of repeating the operation in a few days, as the beaver immediately repair the damage and set up housekeeping as though nothing had ever happened. We realize that this kind of work cannot go on indefinitely, and we have settled on a permanent plan of solving the situation, and have started at the work.



A BEAVER AT WORK

The state owns 360,000 acres of forest lands in Oneida, Vilas and Forest counties, and we have trapped and shipped 30 beaver and liberated them on these lands. We had several colonies located on these lands prior to this shipment, which furnishes a sufficient number to guarantee the perpetuation of the species on lands where they will be immune from interference with any individuals' right and where they have sufficient space to spread out and replenish the earth.

Now that we have performed real conservation in this work, we recommend that our laws be so amended that this commission will be authorized to allow the farmers on whose lands a beaver colony is located and doing damage, to allow the farmer, under licensed supervision to capture the beaver and free the state from further annoyance. Further in this connection, it is well to know that many of the beaver colonies are located where they are doing no damage and no objections are raised to their remaining undisturbed.



A BEAVER DAM IN ASHLAND COUNTY, WISCONSIN

PROTECTIVE ORGANIZATIONS.

It has been the policy of this department to coöperate with the various protective organizations throughout the state. There are 86 of these organizations working under various names, but all with the one aim in view, that of protecting the wild life of the state and cultivating public sentiment favorable to the great scheme of conservation. We cannot overestimate the value of these organizations, as their activities extend into every county of the state and form a substantial support to this commission. These organizations have a combined membership of ten thousand sportsmen substantially interested in seeing to it that we have a wholesome and respectful observance of the law and a proper system of protection established in their various localities. During the past year we have established several of these organizations and shall continue this policy in the future, for we believe that in organization there is strength and strength is needed to perform the mission for which this commission was created.

EDUCATION.

In order that we have a lasting and wholesome appreciation of the value to humanity of the wild life of the nation, we must spread abroad the knowledge of the relations these natural resources bear to the lives and comforts of the people. No human being with a heart and conscience would raise a hand to harm or destroy a living creature that to him meant a lessening of his own individual benefits. Therefore it is of the utmost importance that these facts be made known to the people through a thorough program of education carried on, we believe, through our public schools of the nation. Textbooks with illustrations should be provided for the primary departments of all of our schools and a period for class recitations established, making it a permanent study in the curriculum of the public schools.

The adding of this study to the school curriculum would not only spread a knowledge of this important subject, but would be a source of enticement for the child's love for school. He would look forward to the period of class recitation as the brightest period of the school day and his interest would soon be made manifest in carefully protecting, caring for and encouraging the lives of these winged creatures which he has learned to love. The youths of today are the grown-ups of tomorrow and it is to them we must look to carry forward the work of conservation in its fullest sense.

Wisconsin with her boasted educational institutions consisting of the best university in the United States, eight normal schools, six thousand six hundred and thirty-six one room country schools, six hundred fifty state graded schools, three hundred fifty high schools and many subsidiary schools, and not one of them so far as we are able to learn have either study or recitation period devoted to the life, habits, customs or benefits that the wild life of the nation holds for the people. It is the same as leaving off the connecting rod of an engine which transmits the power of the engine to the propeller. The schools are the connecting rods that would transmit the power of education and crystallize a public sentiment irresistible in its force for conservation.

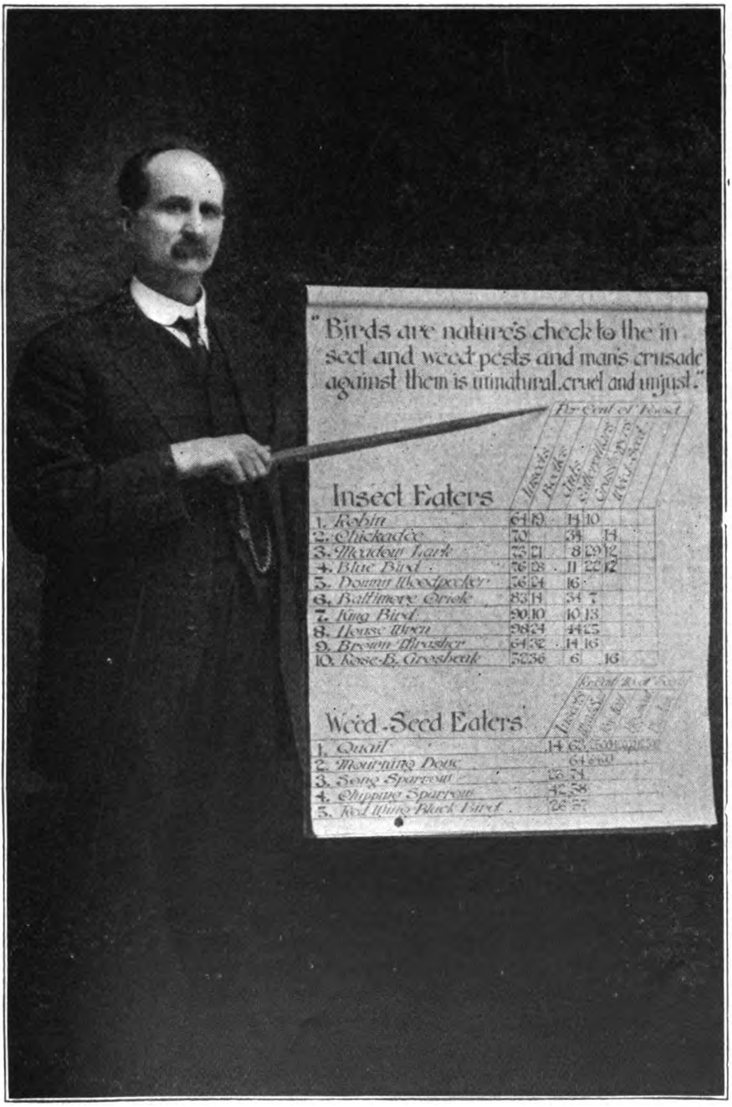

"Birds are nature's check to the insect and weed pests and man's crusade against them is unnatural, cruel and unjust."
Per Cent of Food
Insects
Beetles
Ants
Caterpillars
Grasshoppers
Wild Seed
Insect Eaters
1. Robin 64 19 14 10
2. Chickadee 70 34 14
3. Meadow Lark 73 21 8 29 12
4. Blue Bird 76 28 11 22 12
5. Downy Woodpecker 56 24 16
6. Baltimore Oriole 83 14 34 7
7. King Bird 90 10 10 13
8. House Wren 98 24 44 25
9. Brown Thrasher 64 32 14 16
10. Rose-B. Grosbeak 52 36 6 16
Weed-Seed Eaters
1. Quail
2. Mourning Dove
3. Song Sparrow
4. Chipping Sparrow
5. Red Wing Black Bird

CHART USED IN LECTURES. EDUCATIONAL FEATURE

It is strange indeed that a nation so progressive as this, grasping every new idea (many of them that seem more speculative than enduring) should neglect such an important question, whose only true solution is

COW ELK IN STATE GAME FARM

education, and allow the old hammer and tongs method to supersede enlightened reason.

To the school program of education should be added public lectures given to audiences of adults throughout the various states, which would soon awaken a general interest in conservation that would endure for all time. This commission has already started this latter program and has had several speakers engaged in delivering lectures during the past winter. We shall enlarge upon this work and push this program of education to the best of our ability. It is the one thing that will save the wild life of this nation, and the work must be pushed vigorously. Until such time as the people become educated to the importance of a united public sentiment for conservation, we must pursue the course of warrants, courts and fines and follow the old method of educating with the sledge hammer, teach through fear instead of reason, and the more rigid the laws and the more severe the fines, the more potent the effect.

GAME FARM.

The Wisconsin Game Farm located at Trout Lake, Vilas county, is of considerable importance as a nursery for orphan fawns that are found wandering through the woods with no mother to nurse them and facing starvation. It is surprising how many of these helpless little creatures are rescued by wardens and settlers and sent to this farm where they are fed and cared for. We have in the enclosure at the present time about 100 deer, many of which were orphan fawns that have grown to maturity and form a large herd of breeders that are multiplying rapidly.

In 1913 the former game warden department secured a carload of elk from Yellowstone Park and placed them within the enclosure of the game farm. The long distance shipment and the inclement weather encountered on their journey resulted in the death of all but two, both of which are females, and they are still on the farm. This commission after continued effort, finally secured through the generosity of Charles Comiskey, president of the White Socks Base Ball Club and also president of the Jerome Hunting and Fishing Club, a fine bull elk which he presented to the state free of charge. This gives the state a nucleus for a herd and as they are all acclimated, we feel confident that we will soon have a considerable herd. A vote of thanks is due Mr. Comiskey for his generous gift, which is highly appreciated by this commission.

It is planned by the commission to secure a few moose for breeders and place them on the farm, as it is highly important that Wisconsin should bring back again this animal that at one time was quite plentiful in the far north regions of the state. There is no question but that moose are adapted to that section of the country and they should be encouraged as one of our game animals.

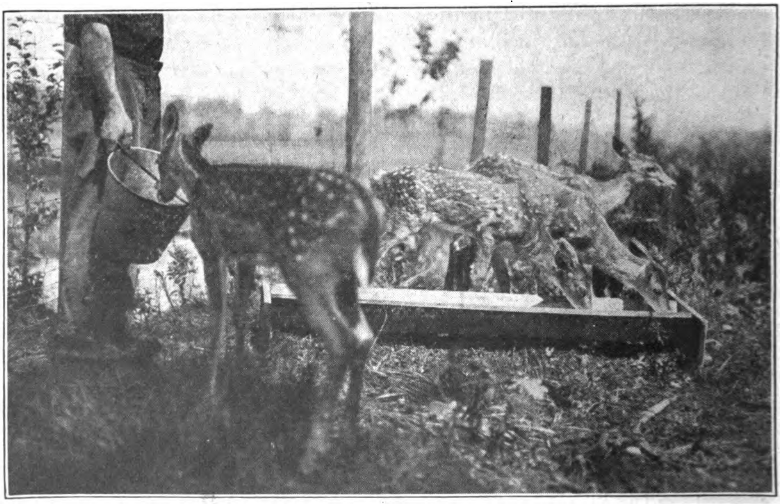
The Wisconsin Game Farm contains about 300 acres of wild timber land and is enclosed with a woven wire fence 10 feet in height. It answers a much needed requirement and will be enlarged from time to time as our animal stock increases. We shall endeavor to secure another carload of elk next year, as we are nicely equipped to handle them and the expense of securing them is not great. Most of the expense is the transportation charges, as the government will furnish them for the expense involved in capturing them.

OSHKOSH HEADQUARTERS.

Soon after this commission assumed the management of this department, we discovered that the most extensive hunting and fishing grounds of the state were at the confluence of the Fox and Wolf rivers, Lakes Winnebago, Poygan, Big and Little Butte des Morts, in Winnebago and Fond du Lac counties. This territory had never had adequate warden service and the most flagrant violations of the fish and game laws were constantly taking place, and wholesale slaughter of both fish and game had become the chief occupation of a number of market hunters. They had built up a profitable business at the expense of the law-abiding citizens.

It was important that this practice be stopped, and in proceeding we established a headquarters for a corps of wardens at Oshkosh by providing an office in the state fish hatchery, equipped with telephone, and other accessories necessary for commodious sleeping apartments, a sufficient fleet of boats, motorcycle and automobile for patrolling the territory, a spacious boat house for securely caring for the boats. It has resulted in a general cleaning out of the offenders and has established a wholesome observance of the law that is redounding to the conservation of both fish and game.

Arrests have been many and the heavy fines inflicted by the courts at Oshkosh have become an obstacle of terror to the violaters. One visit to his Majesty's court has sufficed their appetite for illegal game, and they have concluded that it pays to observe the law.



FEEDING THE FAWNS. STATE GAME FARM. TROUT LAKE

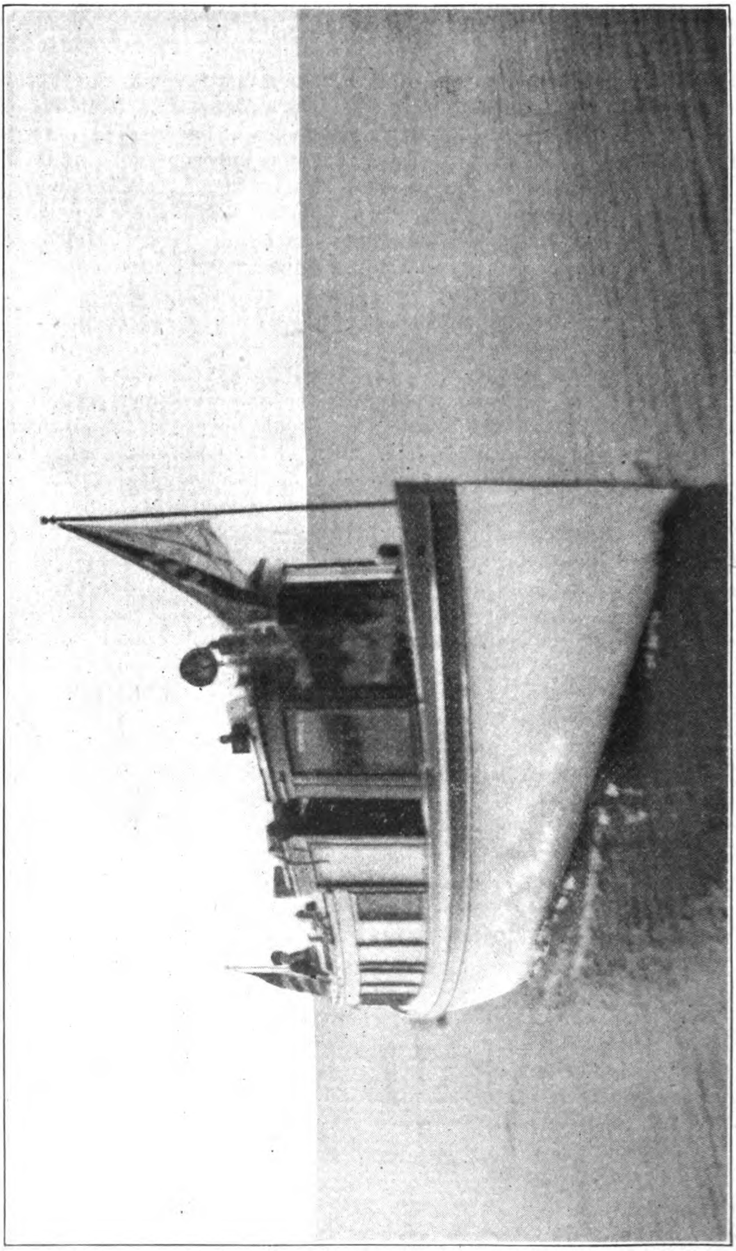
COÖPERATION.

The Conservation Commission should have a more general coöperation of the people in the work we are doing. It is a physical impossibility for us to suppress violations without the assistance of law-abiding citizens, but a feeling exists among the people that it is unbecoming to report to an officer of this commission violations, and instead, they proceed to criticise this department because we are not on the spot the moment a poacher in some remote district commits a violation. Many people view a conservation warden as an undesirable citizen having received his appointment as a compensation for political services rendered. This is entirely an erroneous idea, as the warden service is under Civil Service laws and all wardens are instructed to devote their entire time to their official duties. We believe this department merits the most generous coöperation of the people, as we are engaged in a work most important to every individual within the state. We should have your moral as well as your active support in the enforcement of the laws. We know that many people do not understand the relations this commission bears to the well-being of the people. We are officers appointed to conserve the only natural resource that it is possible to destroy and exterminate. Then tell us why, if you believe these natural resources should be conserved, that every citizen should not volunteer his hearty coöperation.

No other natural resource can be destroyed. The land, the lakes, the rivers and forests are indestructible. All of these will remain with the people to the end of the earth. But the wild life which constitutes one of our greatest blessings can be exterminated and when once gone it is gone forever. We have an example of the utter disregard of the people for these species in the passing of the passenger pigeon. That bird is gone forever. Not one living bird of that specie remains on earth, and just a few years ago they were here in countless millions. This is the one black spot on our civilization that cannot be removed, and we should guard well lest we repeat the error by adding more to the list with the passenger pigeon.

STATISTICS.

The State of Wisconsin is without any statistics as to the amount of game and fur bearing animals that are taken in the state each year. This is a condition that should not exist. This state should know approximately the number of each variety of animals and game birds taken. We have worked out a plan whereby we believe we can secure this valuable information, and which we think will interest every citizen that is interested in knowing the value of this resource to the people. Our department received a letter from Washington, D. C., asking us how many ducks were killed in Wisconsin during the open season of 1915 and we were unable to give them any sort of information on this subject. There has never been any system of taking this census which we believe to be a most important factor if we are to intelligently provide laws that will meet the demands necessary for systematical conservation.



WARDEN PATROL BOAT "GALATEA"

We propose to attach to each hunting license sold a coupon with columns designating at the top the name of each variety of game or fur bearing animal. At the expiration of the license, the purchaser will return to his local county clerk the coupon with the number of each variety taken during the year placed in the column provided for that variety, before another license will be issued to the applicant. These coupons, in turn, to be forwarded to the Conservation Commission by the county clerks.

With this system in force, at the close of the hunting season we will be in possession of information of a most interesting nature which we have no doubt will astonish the most careful students of our game. We believe it will show that our fur bearing animals are producing many thousands of dollars worth of fur and that our game valued alone in dollars and cents will astonish every citizen that reads the report. We believe that the sportsmen will coöperate with us most heartily in securing this information, as it has always been a question that they have wanted solved. We have consulted with several of them as to the practicability of our scheme and they have all acquiesced in the wisdom of securing this information. They also state that it will be no trouble to the hunter to fill out the coupon at the close of the season, for hunters as a rule keep track of their kill just for their own information.

We believe this information will be of great value to our Department of Agriculture in the compiling of the statistics of the state, also our State University will be in possession of information that they have long sought to obtain. It is interesting to know that Wisconsin will be the first state in the Union to obtain this information if our next legislature passes the law legalizing the coupon.

The time is past when we can afford to permit this department to be run in a haphazard manner. It needs the very best supervision that is possible in every branch of its activities, and the more information we can obtain the more intelligently we will be able to administer to its needs.

The following poem written by Dr. Hornaday, director of the Bronx Zoölogical Gardens of New York City, so vividly illustrates the picture of future generations of boys, whose red blood calls them to the GREAT OUTDOOR SPORT, that we print it with our report, as a warning of the responsibility we owe to future generations:

ROBBED

Oh, where is the game, Daddy, where is the game,
That you hunted when you were a boy?
You've told me a lot of the game that you shot,
No wonder such sport gave you joy.
I'm old enough now to handle a gun,
Let me be a sportsman, too.
I'd like my fair run of clean outdoor fun,
And I want to shoot just like you.

But where are the birds, Daddy, where are the birds?
I can't put them up anywhere.
You had your good sport with the wild flocks and herds,
And surely you saved me my share.

And where is the big game that roamed around here,
  When grandfather came here with you?
I don't see one antelope, bison or deer,
  Didn't grandfather save me a few?

Why don't you speak up, Dad, and show me some game?
  Now, why do you look far away?
Your face is all red with what looks like shame,
  Is there nothing at all you can say?
What! The game is all gone! There is no hunting, now!
  No game birds to shoot, nor to see!
Then take back your gun: I'll go back to the plow,
  But oh, Daddy, how could you rob me!

DIVISION OF FORESTRY AND PARKS.

By F. B. MOODY.

All of the powers granted by former legislatures to the State Board of Forestry and the State Park Board, with respect to the management of the so-called forest reserves and state parks, were delegated to the Conservation Commission. The work of the two divisions since August 1, 1915, has been under the direct supervision of the forester member of the commission.

The report of the former State Forester for the two preceding years prior to the consolidation of the Departments was not issued, and it has not been deemed necessary to report on the work of the Forestry Board for that period, except in a general way.

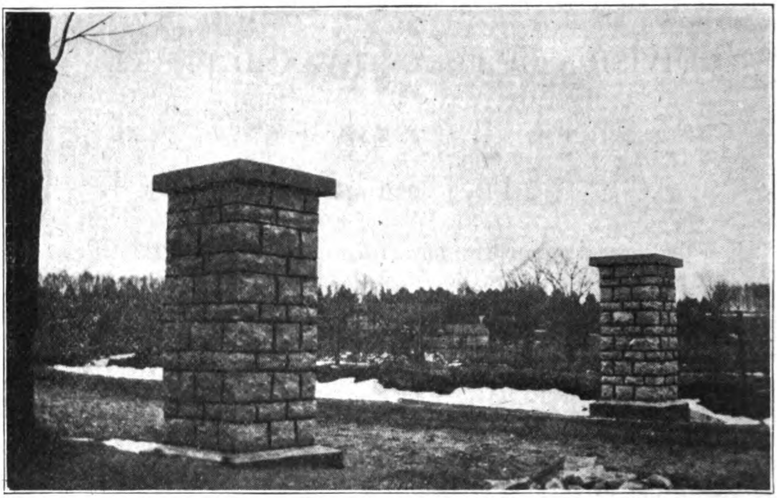
The status of forestry in Wisconsin is a peculiar one, and in order to present the matter clearly, the following statement is made, setting forth the reasons why the whole question was brought before the Supreme Court for adjustment.

THE FORESTRY CASE.

The policy of the Forestry Board in acquiring large tracts of land under a land contract caused the questions to be raised during the 1913 session of the legislature as to whether the purchase of forest reserve lands is not "works of internal improvement" which is prohibited by the State Constitution. Since, upon careful study of the question by the Attorney-General's department, they were unable to find that this question had ever been decided by the courts in any state, they advised that the question be brought before the Supreme Court of Wisconsin. The Court agreed to take original jurisdiction of the case, and it was brought before the Court upon "the petition of the Attorney-General seeking to obtain a writ of mandamus against the defendant, the Secretary of State, to compel the auditing of certain vouchers issued by the State Forester and the issuance of warrants thereon against the State Treasurer for the payment of part of the purchase price of certain lands attempted to be purchased from the G. F. Sanborn company to be added to the State Forest Reserve."

The suit was a friendly one, and the Secretary of State agreed to refuse payment of the vouchers so the case could be brought promptly before the Supreme Court.

Upon the submission of briefs by both sides, other points were brought out, among them: (1) Whether the Forestry Board has correctly construed the Statute in presuming to have authority to bind the State by



ENTRANCE TO THE PENINSULA STATE PARK. FISH CREEK

FORESTRY HEADQUARTERS. TROUT LAKE

long time, interest bearing obligations; (2) whether the basis, itself, of the forestry scheme, the legislative diversion of the land and proceeds thereof granted to the State for particular purposes to a different one, is legitimate; (3) whether using revenues raised by present taxation to promote the production or improvement of forests for the benefit of future generations, is a public purpose within the meaning of the Constitution; (4) whether interest bearing obligations of the State in excess of $100,000 is valid in any event; (5) whether the creation of interest bearing indebtedness of a less amount is valid in view of existing indebtedness of the State to the trust funds or otherwise; and perhaps still others, might, upon due consideration, aided by eminent counsel, be deemed worthy of judicial interference and of being brought to the attention of the courts in this litigation in an appropriate way. The case is of great importance.

"It is therefore considered that the court should and will decline to decide upon the duty of the Secretary of State in respect to making the payments in question on the motion of quash, but will permit such motion to be withdrawn and a return to be made to the alternative writ within thirty days, setting forth by answer every difficulty which he may be advised should be thus set forth in order that all questions in relation to his duty may be so solved as to protect the state and its officers in respect to the use of moneys for forestry purposes which are in the custody of the State Treasurer.

"In case of issue being joined as herein suggested, the Court will aid in reaching a final conclusion speedily by placing the case on the present calendar and advancing it for argument."

The decree of the court was rendered February 12, 1915, and is as follows:

"By the Court: It is considered, ordered, decreed and adjudged that:

"First, The demurrer to defendant's pleading be and is overruled.

"Second. The land contract mentioned in the petition is void for reasons indicated in the opinion, particularly because:

"a. It created a state debt and created such when state indebtedness exceeded the constitutional limit.

"b. It is an evidence of indebtedness within the state constitutional prohibition.

"c. The contract was not authorized by statute.

"d. By section 10, Art. VIII, at the date of the contract, it is fatally within the 'Works of internal improvement' feature of the forestry statutes (though they are in important features, as indicated in the opinion, not so tainted) and the addition, in form, to such section in November, 1910, failed for reasons stated in the opinion.

"e. It is an inseparable part of the forestry legislation and particularly of the invalid features thereof stated in the opinion.

"Third. The forestry legislation, including section 1072–1, Chapter 367, Laws of 1897, Chapter 450, Laws of 1903, and Chapter 264, Laws of 1905, and such other acts as there may be, did not repeal or affect sections 250 and 251, Stats. 1898, for reasons cited in the opinion. Such sections are part of the written law of the state and govern the matters therein referred to.

"Fourth. All land derived by the state from the United States under the swamp land grants, the lands in lieu of swamp lands, set aside for educational purposes under Chapter 537, Laws of 1865, and confirmed by Chapter 151, Laws of 1869, and subsequent practice, and all other lands so derived or in lieu of swamp lands and required to be set apart under the terms of said sections 250 and 251, by section 2, Art. X of the constitution and the legislative action referred to became, and so far as not dised of are, school fund lands, as regards the manner of handling the ie, subject to the constitutional duty to conserve the same for the pure of producing money for the school fund, as indicated in the opinion; under the control of the legislature in respect to the manner of dealing rewith for such purpose.

Fifth. The sections of the statutes composing Chap. 740, Laws, 3, and those composing Chapter 491, Laws of 1907, are unconstiial for the reasons stated in the opinion.

Sixth. The provisions of the forestry legislation, other than the es mentioned, are valid within limitations, stated in the opinion.

Seventh. The state has an equitable lien on the lands included illegal contract for the money paid thereon, and such money, equitable leclared to have been trust money, whereby such lien inures to the efit of the trust fund property.

Eighth. For the benefit of the trust funds, the balance due on the tract shall be paid out of trust fund money when practicable, and to vide therefor, all moneys to the credit of the forestry fund derived n sales of land, or from appropriations to buy lands, or in the tax title d referable to sections 1494–131 to 135 inclusive, Stats. 1913, are deed to equitably belong to the drainage and constitutional trust funds, ause of the diversion of such funds to forestry purposes and to the eral fund, and the resulting confusion, the whole is declared to have character of the more important funds which have wrongfully lost ir identity, and such equitable status shall subsist so far as necessary ully remedy the diversion and confusion.

Ninth. The newly acquired lands under the forestry law, except those iated to the state for forestry purposes, have the cast of the constituial trust fund lands and will be administered accordingly until, upon a accounting it shall be found what part, if any, will remain after fully toring the integrity of the trust fund lands and trust funds.

Tenth. The facts being admitted, the alternative writ of mandamus lismissed, but the cause retained for the purpose of final disposition on the coming in of the report of the referees hereinafter appointed.

Eleventh. There shall be an accounting which is hereby ordered of all lings with the trust fund lands of the date of Ch. 367, Laws of 1897, so long prior thereto as practicable, not earlier than the decision under ipter 537, Laws of 1865,—and of lands acquired under the forestry slation since 1897, except those donated to the state for forestry pures or acquired by proceeds of the latter, and an accounting of all products of such trust lands and income thereof and income which such ceeds would have earned had the same been devoted to the trust to ch they belonged, such accounting to include all moneys paid into the stry fund or general fund, derived from trust fund land or lands pursed therewith and income from such proceeds, and a partition shall made of the entire property so found equitable and legally to belong the constitutional trusts, including any indebtedness from the general d; giving due credit for all proper disbursements chargeable to such st funds,—so that each of the constitutional trusts will have their iitable and legal portion of the trust fund property with identity ablished as to lands and other assets, as near as may be, after the nner of the decision under Chapter 537, Laws of 1865. Such accountshall include all matters not specifically mentioned so far as necessary cover the field discussed in the opinion and carry out the intent thereof ded by such opinion; and the referee shall report the result of the acnting to the court with all convenient speed.

For the purposes of the accounting the cause is referred to the comsioners of public land and Judge Samuel D. Hastings as special referee.

The holders of land contracts like the particular one shall be bound the decision herein subject to the right of any vendor or assignee of h vendor to show cause why to the contrary within twenty days after vice of a copy of this order on such vendor or assignee and notice to w such cause within such time or be so bound, and such notice in writing shall be given, so far as practicable, within twenty days after the entry hereof and proof be filed as part of the proceeds of this case.

"Administrative orders will be accorded, if necessary, for further guidance in the course of the accounting, to the end that this determination may be fully carried out according to the intent thereof.

"Upon the coming in and confirmation of the report of the referees, judgment shall be rendered in respect to the matters covered thereby in accordance with such confirmation."

In a concurring opinion, Chief Justice Winslow does not share the doubt in regard to the right of the State to raise taxes in acquiring and handling land as a forest reserve. It is as follows:

"My difficulty with the opinion" (of the court) "stated in a general way, is this: It so limits and circumscribes the powers of the state with regard to the afforestation and reforestation that it leaves little more than a shell behind. At least this is the way the opinion impresses me and the way I think it will be generally understood.

"There are three general propositions which I think should be stated in this case clearly and fully, without hedging them about with limitations, qualifications, and provisos which render them practically useless, and those propositions are as follows:

"First, the acquisition, preservation, and scientific care of forests and forest areas by the State, as well as the sale of timber therefrom for gain in accordance with the well understood canons of forest culture, is preeminently a public purpose. It would be a mere affectation of learning to dwell upon the value to a state of great forest areas. That has been established long since and is not open to question. The lamentable results which have followed the cutting of forests over large areas, the serious effects of such cutting upon climate, rainfall, preservation of the soil from erosion, regularity of river flow, and other highly important things which go to make the welfare of the state, are matters of history. They need not be descanted upon.

"Second, before a public purpose of the first rank in importance, there can be no question of the power of the state to levy taxes for the accomplishment of the purpose. The power of taxation exists for every public purpose unless some constitutional prohibition, either federal or state, has taken it away. I find no such prohibition. I confess my inability to understand the reasoning which finds it in that clause of the Constitution which commands the legislature to levy an annual tax to defray the estimated expenses of the state. The power of taxation is one of the necessary attributes of sovereignty. To say that, because the Constitution makers thought best to make a specific provision that taxes should be levied for certain purposes, they intended thereby to interdict taxation for all other purposes, is to my mind unthinkable. Besides, if afforestation and reforestation be public purposes, then the moneys spent in carrying them on are necessarily and properly expenses of the state and come within the constitutional command. The expenses of a state include the moneys which it spends in carrying out the public purposes which the legislative judgment directs to be carried out.

"Third, afforestation and reforestation of large areas are not 'works of internal improvement' within the meaning of the Constitution. In stating the proposition, I accept the definition given in the case of the *State vs. Froehlich*, 115 Wis. 32; 91 N. W. 115; 58 L. R. A. 757; 95 Am. St. Rep. 894. It was there said that the term includes 'those things which ordinarily might, in human experience, be expected to be undertaken for profit or benefit to the property interests of private promoters, as distinguished from those other things which primarily, and preponderantly merely facilitate the essential functions of government'. In the same opinion it was said, in substance, that this classification does not exclude the possibility that some of the dominant characteristics of one class may be present, but, of course, not dominantly in illustrations of the other class.

"Now I affirm that it is not to be expected in the light of human experience in this land at least, that the establishment and conservation of great forest areas for the public good should be undertaken by private enterprise, and I also affirm my belief, as previously stated, that such work is preëminently a public work, and hence one of the essential functions of government. It has not been recognized as such until recently perhaps, but that is merely because the conditions which make it such have only recently arisen and become acute. So in my judgment every act which is necessary to be done in successfully carrying on afforestation and reforestation, including the purchasing of the necessary lands, may properly be done by the state. My original opinion was that this might properly be done by the state. My original opinion was that this might properly include the erection of sawmills and the manufacture of lumber out of the timber which under the rules of scientific forestry ought to be cut, but I yielded my opinion on this point, and I stand by the concession. I do think, however, that it covers every necessary and proper act up to and including the sale to third persons of standing timber which ought to be cut.

"I have not desired to argue out these propositions, but only to state them." (Northwestern Reporter, Vol. 151, No. 3, pp. 377–378, *State vs. Donald.*)

Following out the decree of the Court, a special referee (Samuel D. Hastings) was appointed to render the accounting ordered by the court (see 11th item of the decree). Mr. Hastings, with reference to the newly acquired lands, says in part:

"The judgment is that they 'have the cast of the constitutional trust fund lands and will be administered accordingly, until upon a full accounting, it shall be found what part, if any, will remain after fully restoring the integrity of the trust fund lands and trust funds.' The accounting shows a large indebtedness to each of the four constitutional trust funds. The integrity of said funds will not be fully restored until all of said indebtedness is paid. The reason for such lands having such cast is stated in the opinion as follows: 'On account of the unwarranted confusion of the different classes of trust fund lands with lands purchased by proceeds of trust fund lands and other moneys, including money drawn from the general fund, and income from trust funds and other confusions, all must be regarded as having the cast of trust fund lands and money, so far as necessary to the full restoration of such trust fund lands and property, and identification of the amount belonging to each fund as to the date of chapter 367, Laws of 1897, and further back if found practicable.' " * * *

"I have construed the opinion and judgment of the court to be that upon the facts and conclusions pointed out in this report all the newly acquired lands have the cast of Normal School lands, and are to be administered as such until the entire debt of the General Fund as found in this report is fully paid.

"Following the interpretation of the Court's opinion and judgment, and of the constitution and statutes, as above explained, I find and report:

1st. As to the Normal School Fund:

(a) All of the lands conveyed to the State of Wisconsin pursuant to the provisions of the Act of Congress approved September 28, 1850, and the Act of Congress approved March 2, 1855, and known as swamp and indemnity lands, respectively, to which the state still holds title, belong to the Normal School Fund. * * *

"(m) The General Fund is indebted to the Normal School Fund in the sum of One Million Five Hundred and Seventeen Thousand Five Hundred and Fourteen Dollars and Twenty-three Cents. ($1,517,514.23), which arose as follows:

1. The value of Normal School lands given away without consideration	$96,063.14
2. Moneys belonging to the principal of this fund placed in income fund and spent	70,939.02
3. Moneys taken from the principal of the trust fund and used as part of the General Fund for general state purposes	515,700.00
4. Proceeds from sales of Normal School lands, paid into and used as part of the General Fund	419,674.69
5. Proceeds from sale of Normal School lands paid into the Forest Reserve Fund and used for forestry purposes	414,162.20
	$1,515,539.05
6. One-half amount received from Fuller and others for interest in swamp lands patented to state	1,975.18
	$1,517,514.23

"(n) The Normal School Fund has a lien upon all the lands acquired by the state under the 'forestry laws,' either by purchase or by tax deeds, for the full amount of said indebtedness of the General Fund to said Normal School Fund. All of said lands have the case of Normal School Fund lands, and are to be administered as such until upon a full accounting it shall appear that said indebtedness has been fully paid from the proceeds of said lands or other sources. Said lands are described in Schedules I and K. The quantity shown is 157,091.44 acres."

Under the decision the Conservation Commission having as a primary object the production of school fund money, has the right to manage all of the state lands with the exception of the school lands proper, which are small in amount, totalling some 12,100 acres. Therefore, it is possible for the State to hold the forest lands now possessed and to acquire other lands, provided such purchases are made to enhance the value of the trust. With the same object in view, it is possible to reforest portions of the so-called forest reserve.

The Supreme Court decision did not, in any way, affect the management of the State Park properties, or lands granted to the State for forestry purposes.

GRANTS OF LAND FOR FORESTRY PURPOSES.

Under the Federal grant of 1906, approximately 20,000 acres of vacant government land were transferred to the State for forestry purposes. The act provides that any or all of the land may be sold with the consent of the Secretary of the Interior, provided the proceeds be used only in the reforestation of the permanent reserves.

Of this grant 5,963.47 acres have been sold for a price of $21,966.92, which constitutes a reforestation fund, in which there is now a balance of $9,284.00, and more than two-thirds of the lands are still held, which are probably worth from $45,000.00 to $50,000.00.

In 1912 another grant was made conveying all of the unsurveyed and unattached islands to the State north of Town 33, to be used as additions to the forest reserve only. Some 637 islands totalling about 875 acres have been surveyed and listed to date.

Since these islands cannot be sold, under the terms of the grant, the policy of leasing them for summer resort and camp site purposes was adopted. The annual revenue from island leases to date is $862.00 for 38 islands. It is expected, however, that they will eventually bring in an income of approximately $10,000.00 per year, as may be seen from the following table:

ISLANDS GRANTED TO WISCONSIN BY THE UNITED STATES.

County	Number	Acreage
Ashland	5	8.28
Barron	35	16.64
Bayfield	40	56.42
Burnett	47	58.64
Douglas	7	23.43
Florence	18	17.02
Forest	13	27.88
Iron	44	30.17
Langlade	3	1.80
Lincoln	6	5.55
Marinette	5	1.47
Oneida	99	154.84
Polk	43	55.33
Price	15	11.80
Sawyer	48	104.96
Vilas	111	107.92
Washburn	98	162.99
	637	875.14

NEBAGAMON LUMBER COMPANY GRANT

In 1907 the Nebagamon Lumber Company granted to the State 4,321.07 acres of land in Douglas county under the following conditions: "The said lands to be used for forestry purposes only and should the same be no longer used for said purpose, the title of the same is to revert back to the party of the first part." These lands are worth approximately $20,000.00.

A portion of this grant lies along the Brule river, which rises near the upper St. Croix Lake, flows north through the eastern part of Douglas county and empties into Lake Superior. Such portions of the land as border the stream have been surveyed into lots to be leased for camp and cottage sites, and will be managed as a State Park rather than as a Forest Reserve.

PURCHASED LAND.

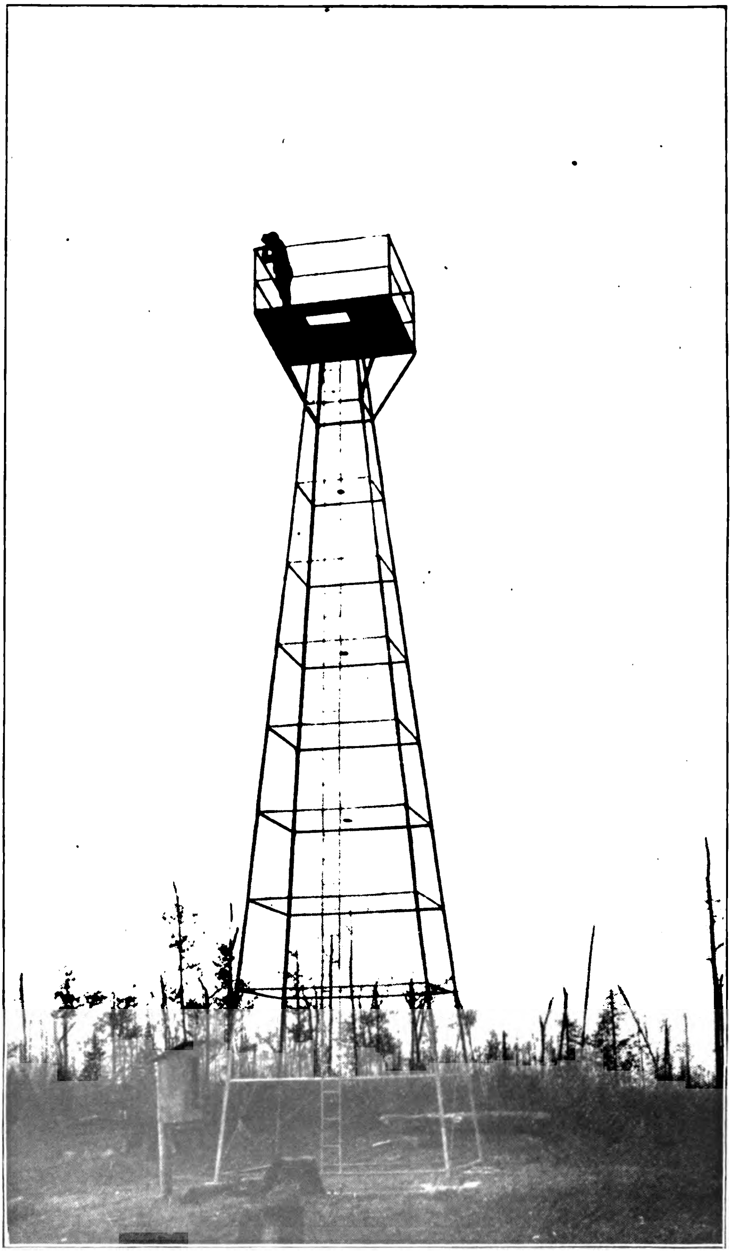
There was purchased by the Forestry Board approximately 159,000 acres in Douglas, Iron, Oneida, Vilas and Forest counties. This land was acquired at an average price of $3.45, including three purchases of heavy standing timber as follows:

	Acres
Acreage purchased from $2.00 or less to $2.56	60,217.62
Acreage purchased from $2.68 or less to $3.50	56,972.54
Acreage purchased from $3.75 or less to $4.60	38,451.95
Acreage purchased from $5.00 or less to $6.50	3,270.67
Over $6.50	90.77
Total Acreage	159,003.55
Total Cost	$548,562.24

THE FOLLOWING TABLE GIVES THE ACREAGE BY COUNTIES OF LANDS GRANTED TO THE STATE UNDER SWAMP AND SCHOOL GRANTS, GOVERNMENT REFORESTATION GRANT, NEBAGAMON LUMBER COMPANY GRANT, ISLAND GRANT AND LANDS PURCHASED FOR FORESTRY PURPOSES.

	Swamp, School, Etc. Acres Vacant.			Govt. Reforestation Grants.		Acres Purchased as additions to forest reserves.
	Swamp	School	Agric. Coll. & University.	Acres Vacant	Total Granted	
Adams	120.72	160.00				
Ashland	3,685.76	160. a		360.00	440.00	
Barron		40.00				
Bayfield	909.02	80.00		270.58	758.42	
Buffalo	551.42		U. 36.90			
Burnett	2,294.86	1,120.00		1,354.30	4,069.28	
Chippewa	204.24					
Clark	1,025.80		U. 40.00			
Crawford	1,115.02	.27				
Dodge	.66					
Door	37.00	40.00				
Douglas	716.02	280.00		1,241.23	1,909.73	605.68
Dunn	204.50	280.00				
Eau Claire	211.02	200.00	U. 83.73			
Florence	3,598.44			80.00	80.00	
Forest	33,572.12	1,565.50		240.00	240.00	1,919.29
Grant	40.60					
Iron	21,772.71	1,329.80		506.74	707.14	7,016.21
Jackson	1,526.99	360.00				
Juneau	50.00	154.50				
La Crosse	200.27					
Langlade	1,258.00	80.00		40.00	40.00	
Lincoln	961.32				95.60	
Marathon	160.00					
Marinette	4,860.74	139.87		447.10	447.10	
Marquette	134.68	60.00				
Monroe	120.00	440.00				
Oconto	1,000.30	40.00				
Oneida	42,507.64	1,660.80		3,167.67	3,167.67	34,842.20
Pepin	111.41					
Pierce	62.77	1.10				
Polk	225.85	840.00		646.00	686.40	
Price	17,872.04	360.00		1,075.69	1,750.69	
Richland	15.54					
Rusk	2,394.96					
Sawyer	8,677.23	560.00		1,711.00	2,336.90	
Shawano	279.55					
Taylor	1,882.54	40.00	A. C. 40.00			
Trempealeau	110.90					
Vernon	523.39					
Vilas	12,223.39	1,242.60		2,444.57	2,444.57	114,889.79
Washburn	2,051.28	840.00		433.15	817.40	
Waukesha		Vil. Lot				
Waupaca	40.00					
Winnebago	447.06	80.00				
Islands in Lakes, various counties		32.02				
	169,647.76	12,107.26	200.63	14,027.43	19,990 90	159,273.17

Lands in Douglas county granted by the Nebagamon Lbr. Co., ... 4321.07 A.
Islands conveyed by U. S. for forestry purposes in various counties .... 875.00 A.
a. 80 acres escheated lands.



FIRE LOOKOUT STATION. FOREST RESERVE

Note: By triangulation methods a fire may be quickly and accurately determined and located.

FOREST PROTECTION.

The protection of forests from fire is the first essential in the development of a forest policy for a State. Past experience has proven that the forests of Wisconsin have suffered great damage from fire at times, and, without question, history will repeat itself in the future, unless a well planned fire organization is developed, to be ready for the real dry season.

The protection of forests from fire in the north one-half of the State is brought about through an organization of town fire wardens, assistant fire wardens and the protective force of rangers and patrolmen in what is known as the forest reserve region. The town fire warden system is established by having each town chairman become ex officio fire warden and the road superintendents, assistant fire wardens. The chief duties of the fire wardens, of whom there are about 555 in the territory, in which there is a fire hazard, are the fighting of fires, instead of prevention and detection. The system of fire protection as applied to the greater part of the State lands or the so-called forest reserve area is one of *prevention, detection and control.*

The present forest fire organization outside of the protected area is inadequate since there is no definite plan of detection and prevention. The local wardens usually will wait until fires are upon them before taking any protective measures. From a conservation standpoint, forest fire prevention is the most important feature. Therefore, adequate appropriation should be made through State taxation to make it possible to provide for the appointment of so-called district fire wardens, whose duties would be to coöperate with the local fire wardens, timber owners, and others, throughout the entire wooded area of the State.

The protected area, within which the greater protion of the State reserves is located, includes 1,250,000 acres in Forest, Vilas, Oneida, Iron and Price counties. In protective work, over this entire area the State is aided by the Federal Goverment under the Weeks Law, and by individuals and companies owning large tracts of lands within its borders. This area is divided into 17 districts, varying in size from 66,000 to 138,000 acres. A ranger or patrolman is in charge of each district. Protective work is facilitated by a telephone system, a network of roads and trails, proper means of transportation and lookout towers, the latter making it possible to observe over one-half of this area.

The cost of protecting this one and one-fourth million acres of land was one and one-third cents per acre in 1915. It is proposed to gradually extend the lines of protection as funds and outside coöperation become available.

FOREST FIRE ORGANIZATIONS.

As an example of the development of organized effort of timberland owners in the prevention of fire, the following data was compiled from reports of several associations. Organized effort on the part of timber land owners in this state would do much toward solving the fire problem. An organization covering three or four counties lying contiguous would be the most effective since an opportunity would present itself of close coöperation with the Federal, State and town wardens and patrolmen.

COMPILATION OF DATA ON FOREST FIRE PROTECTIVE ASSOCIATIONS.

Name of Association	Address	Date of report	Acreage protected	Public acreage	Private acreage	Total cost per year	Assessment per acre	Max. No. wardens	
Klamath Lake Counties Forest Fire Protective Association	Klamath Falls, Ore.	1915	449,888		449,888	$7,535.26	.01		Private, with State Coöperation.
Douglas County Fire Patrol Assn.	Roseburg, Ore.	1915	801.557	535,275	266,282	9,271.54	.012	35	State, Federal & Private Coöperation.
Coos County Fire Patrol Association	Marshfield, Ore.	1915	460,446		460,446	9,208.92	.02	23	State, Federal & Private Coöperation.
Polk County Fire Patrol Association	Dallas, Ore.	1915	117,205	12,587	104,618	1,758.08	.015	10	State, Federal & Private Coöperation.
Union-Wallowa Counties Fire Assn.	La Grande, Ore.	1915	317,913		317,913	3,078.95	[3].01 [4].005	11	State, Federal & Private Coöperation.
Washington Forest Fire Association	Seattle, Wash.	1915	2,586,409			46,022.01	.02	85	Chiefly a private organization, but coöperates with State & Federal Governments.
Northern Montana Forestry Association	Kalispell, Mont.	1915	706,746	[1] 345,317 [2] 361,429		1,470.27	.01	19	State, Federal & Private Coöperation.
Central Pennsylvania Forest Fire Protective Association	Snow Shoe, Pa.	1915	300,000			690.37		26	Private & State Coöperation. Depends on small assessments and gifts from land owners.
Pocons Protective Fire Association	Monroe County, Pa.	1915	212 members. No statement of acreage			503.06		7	Private. Depends on small assessments and contributions for support.
Central West Virginia Fire Protective Association	Elkins, West Va.	1915	No statement of acreage			3,828.93		16	Private principally, but receiving aid under Weeks Law.
Kennebec Valley Protective Association	Bingham, Maine	1915	1,250,000			2,024.86	1½ mills		Private concerns.
New Hampshire Timberland Owners Assn.	Gorham, N. H.	1915	930,540		930,540	6,699.07	¾c	17	Private concerns.
Vermont Timberland Owners Assn.	Bloomfield, Vt.	1915	275,128		275,128	1,928.09	.01		Private concerns.
Northern Forest Protective Association	Munising, Mich.	1915	1,000,000		1,000,000		.01		Private concerns.

(1) Federal. (2) State & private. (3) Timbered Land. (4) Cutover Land.

FROM 1908 TO 1914 INCLUSIVE.

	Contributing area.	Protection cost.	Annual cost per acre	Average number of fires per year	Average number of acres burned annually	Average number M. B. F. timber burned annually
Potlatch Association	310,000	$32,080	$0.10	41	21,136	111,963
Clearwater Association	411,000	$22,127	$0.05	54	10,139	165,462
Coeur D'Alene Association	439,000	$27,387	$0.06	66	2,815	12,500
Pend Oreille Association	445,000	$18,736	$0.04	97	16,660	1,268

LOCOMOTIVE INSPECTION.

The coöperative work with the railroads running through the forest regions of the state has been continued with splendid results during the past two seasons. There has been a steady improvement in the type of equipment used by the various roads and especially in the general upkeep of the spark arresting devices.

Following is the report of Mr. A. E. Hoffman, Merrill, covering the work from May 1, to November 1, 1916.

Wisconsin Conservation Commission,
Madison, Wisconsin

Gentlemen:—

I herewith submit to you my report of locomotives and rights of way inspected for the past six months, ending October 31, 1916.

The following table shows the number of locomotives inspected each month and their conditions:

	Total.	G.	F.	B.	R.	O. S.
May	91	86	4		1	
June	102	80	16	5		1
July	68	56	7	3	2	
August	39	31	1	4	3	
September	90	79	5		6	
October	131	112	10	2	7	
	521	444	43	14	19	1

The following is a table of the rating of locomotives inspected of the different roads.

The locomotives of the C. & N. W. Ry. and C. St. P. M. & O. Ry. are reported as one for the reason that they are occupying the same round houses in a great many places.

	Total.	G.	F.	B.	R.	O. S.
N. W. Line	186	171	7	0	8	0
Soo Line	96	92	4	0	0	0
C. M. & St. P.	93	85	2	0	6	0
Green Bay & W.	25	20	4	0	1	0
L. S. T. & T. Ry.	19	8	8	2	0	1
Great Northern	16	9	7	0	0	0
Mar. Tom. & E.	6	4	1	1	0	0
Wis. & Northern	6	4	1	1	0	0
D. S. S. & A. Ry.	4	4	0	0	0	0
No. Pacific Ry.	3	3	0	0	0	0
	454	400	34	4	15	1

KEY TO TABLES.
G.—Good.
F.—Fair.
B.—Bad.
R.—In shop for repairs.
O. S.—Ordered out of service.

The following are ratings of the logging locomotives:

	Total.	G.	F.	B.	R.	O. S.
Hines Lumber Company, Park Falls	9	5	0	3	1	0
Rib Lake Lumber Company, R b Lake	6	5	0	0	1	0
Kneeland McLurg Lumber Company, Phillips	5	2	1	2	0	0
Robbins Lumber Company, Rhinelander	5	3	0	2	0	0
Roddis Lumber and Veneer Company, Park Falls	4	3	1	0	0	0
Phelps Bonnell Company, Phelps	4	4	0	0	0	0
Mohr Lumber Company, Hixon Line	3	1	1	1	0	0
Goodman Lumber Company, Goodman	3	3	0	0	0	0
Leona and Northern, Leona	2	1	0	1	0	0
Kneeland & West, Lugerville	2	2	0	0	0	0
Foster Latimer Company, Mellen	2	2	0	0	0	0
Owen and Northern, Owen	1	0	0	0	1	0
Menominee Bay Shore Company, Soperton	2	2	0	0	0	0
Wells Lumber Company, Ellis Junction	2	0	1	1	0	0
Dunbar & Wausaukee Railway, Wausaukee	2	1	1	0	0	0
Westboro Lumber Company, Westboro	2	1	1	0	0	0
Union Land Company, Hixon Line	2	1	1	0	0	0
Turtle Lake Lumber Company, Winegar	1	1	0	0	0	0
Vilas County Lumber Company, Winchester	1	1	0	0	0	0
Menasha Paper Company, Ladysmith	1	1	0	0	0	0
Foster-Mueller Company, Hiles	1	1	0	0	0	0
Marathon County Lumber Company, Stratford	1	1	0	0	0	0
Medford Lumber Company, Medford	1	0	1	0	0	0
Keith & Heil, Crandon	1	1	0	0	0	0
Wachsmuth Lumber Company, Bayfield	1	1	0	0	0	0
Flambeau Lumber Company, Park Falls	1	1	0	0	0	0
Gurney Lumber Company, Gurney	1	1	0	0	0	0
	66	45	8	10	3	0

Of the 521 locomotives inspected, 355 head ends were opened.

215 had the 3 x 3 wire mesh.
107 had the $\frac{3}{16}$ x 1½ perforated plate.
14 had the 2½ x 2½ wire mesh.
11 had the $\frac{3}{16}$ x ¾ draftac wire mesh.
8 had the 4 x 4 wire mesh.

Of the 521 locomotives inspected, 166 were hot and the front ends were not opened, the ash pans only being examined.

You will note that of the total amount of the large type of engines which numbered 454, but 39 defects were found, or 9 per cent, whereas, of the 67 engines used for logging purposes, 18 defects were found, or 27 per cent. In view of these facts, I believe that time would be well spent in keeping a closer watch on the logging engines, rather than calling on the larger round houses so frequently.

The reason of the poor conditions of the logging engines is the frequent changing of crews, and the master mechanic or superintendent of the company neglecting to make personal inspections as to the conditions of same.

Records of head end and ash pan inspections at the larger round houses are kept to date with a few exceptions. Quite a large number of the smaller round houses which are terminals, where they house from two to five engines, keep no record at all.

Of the various kinds of head end spark arresters, now in use, the "Slater Box Front" of the C. & N. W. Ry. is the best. The Master Mechanic front ends used by the C. M. & St. P. Ry., Soo Line, G. B. & W. Ry., and others, are efficient and give very good service if kept in repair.

The "Teepee" stack hood used by the C. M. & St. P. Ry., is a very good one. At that I doubt if it is any better than the one used by the C. & N. W. Ry., which is a much easier one to be made and cheaper in construction. The Soo Line hood is a good one, but a bungly affair, and much more expensive to make than either of the others.

Engine crews with whom I have talked find no fault with the steaming of engines with hoods attached. The objection they have is that the cab is filled with live cinders, making it very disagreeable.

The Soo Line has installed on the sides of all their engines carrying stack hoods, observation windows, which will do away with a great deal of the unpleasant features regarding cinders.

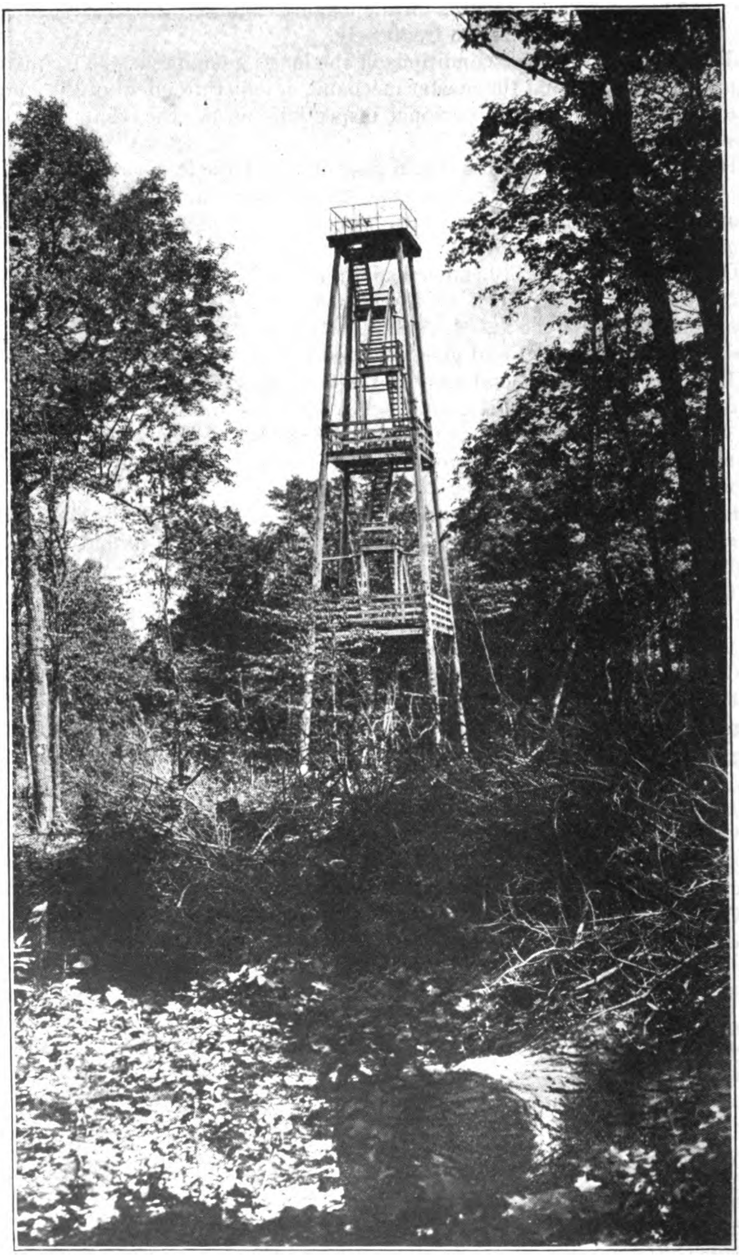
Of all the different styles of ash pans, the hopper slide and C. B. & Q. of the large type of engines is the best. The hopper pan with drop bottom is a very poor one. The only engines equipped with same are the Lake Superior Terminal & Transfer Company of Superior, and they do not leave the yards.

The best pan for the small standard engines is the swipe pan, but I note that the C. M. & St. P. Ry., are replacing same with a shallow hopper pan which is not giving very good satisfaction, by reason of the many openings caused by the slide running through the hopper. The slat bottom pan, of which there are but very few still in use, are the poorest and most dangerous.

Twenty-seven rights-of-way were inspected. Of these, two were found to be "Good." The right-of-way of most of the main lines of the C. M. & St. P. Ry., the N. W. Lines and the Soo Line, are in very fair condition. None of them, however, are strictly within the law, and could be improved upon.

FOREST FIRES IN 1915.

Favorable weather conditions during the past four years have kept the damage of fires to a minimum. At the end of the fire season of 1915, circular letters were sent out to all town fire wardens outside the protected area. The data compiled from the reports of 318 fire wardens is as follows:



LOOKOUT TOWER. 75 FEET HIGH. PENINSULA STATE PARK

Distributed by Causes.

Lightning	4
Railroads	35
Lumbering	2
Brush burning	56
Campers	14
Incendiary	5
Unknown	52
Miscellaneous	6
Total number of fires	174

The total area burned over, including both timbered and open land, was 46,511 acres, while the damage to timber and improvements amounted to $28,132. This data is significant, since the season was a very wet one. In spite of this fact, however, many fires were started and considerable valuable property destroyed. In order that we may be prepared for the real dry periods, which are bound to come in the near future, probably within five years, it is hoped that a well organized scheme of forest fire protection may be developed, and that individuals, corporations and other landowners organize forest fire associations and make it possible to coöperate to the fullest extent with the State throughout the wooded regions.

COÖPERATION WITH FEDERAL GOVERNMENT IN FIRE PROTECTION

In 1911 Congress approved an act (Weeks Law) authorizing the Secretary of Agriculture to coöperate with states in the protection from fire of forested areas at the headwaters of navigable streams, and an appropriation was made available for such protection. Under the coöperative agreement, States were obligated to spend an amount equal to the allotment provided by the government. Wisconsin was one of the first states to coöperate and has received an annual allotment of $4,500.00. Under the agreement entered into in 1916, eight federal patrolmen were appointed by the Conservation Commission for a period of six months and have been given definite districts to patrol and are under the direct supervision of the Head Ranger. During periods of no fire danger these patrolmen are employed in permanent improvement work, such as building trails, fire lanes, telephone lines, roads, etc. A close coöperation exists between the Federal Patrolmen and the State force of eight forest rangers.

PERMANENT IMPROVEMENT WORK

In the development of the forestry work some 37 buildings have been erected to shelter the ranger force at an approximate cost of $28,600. Two forest nurseries have been established which have an output of 1,000,000 trees annually. Other improvement work includes the building of about 250 miles of roads, 140 miles of fire lanes, and 80 miles of telephone lines.

VALUE OF IMPROVEMENTS AND BUILDINGS ON THE STATE FOREST RESERVES.

37 Buildings	$28,690.00
4 Steel Lookout Towers	547.00
86 Miles Telephone Lines	3,151.00
Trout Lake Nursery. (Land improvements, water system with power engine, fencing, nursery frames, etc.)	4,700.00
Tomahawk Lake Nursery. (Land improvements, water system with power engine, fencing, nursery frames, etc.)	2,600.00
Nursery Stock (Trout Lake)	9,385.00
Nursery Stock (Tomahawk Lake)	1,983.00
Implements, tools, wagons, boats, speeders, furnishings for headquarters building, men's cabins, camp equipment for field work	4,100.00
Total	$55,156.00

During the fiscal year ending June 1, 1916, the forest rangers have carried on the general lines of improvement work of keeping open the fire lanes, repair of old roads, trails and telephone lines; the protection of the fish and game within their respective districts, thereby coöperating with the conservation wardens, which not only prevents duplication of work, but also makes for efficiency in both branches of the service.

The organization of the forest fire protective force is given in the appendix to the report and sets forth in detail the duties of the rangers in fire protection.

STATE PARKS.

The first State Park in Wisconsin was established by the legislature of 1878. All state land owned by the state in twenty-three townships in Iron and Vilas counties, some 50,000 acres, was set aside with the express provision that "no authority should be given to anyone to cut down or destroy any timber on such lands." For nineteen years this land was held intact. In 1897 the legislature placed the land on the market, and about 32,000 acres were sold. It is of interest to note that most of this same land, which was sold for approximately $8.00 per acre, was later repurchased by the state for a forest reserve at about one-third of the original price, but with the timber cut. In 1895 a law was passed authorizing the Governor to arrange to acquire 250 acres in what is now known as the Interstate Park, and he was authorized to appoint three Commissioners to examine the land and determine the values. In 1899 the legislature appropriated $6500.00 for the purchase of the lands, and the remainder from the purchase to be available for the general purpose and care of the park.

The first actual purchase of land for park purposes did not take place until 1901. The state has spent $291,571.23 for the purchase of lands for state parks, as may be seen from the following tabulated statement:

PAYMENTS FOR PARK LANDS.

	Interstate	Peninsula	Devil's Lake	Marquette
1901	$ 3,635.00			
1902	3,557.00			
1908	11,959.50			
1909	1,600.00			
1910		$49,649.00		
1911		30,534.20	$19,892.30	
1912		15,999.21	49,434.86	$16,158.93
1913			59,170.28	10,000.00
1914				10,000.00
1915				9,980.95
	$20,751.50	$96,182.41	$128,497.44	$46,139.88

In addition to the appropriations there has been some income from the sale of old buildings, fuel, leases, concessions, etc., which, with the amount left over from the appropriations, makes up the present "Park Purchase Fund," amounting to $12,695.46.

All of the state parks have been designated as wild life refuges, and game is increasing in them. Camping sites are laid out on two of the parks, and these are maintained in a clean and sanitary condition. Maps showing the camp sites are in preparation. Campers are charged 50c per week to pay for supervision and annual cleaning of the grounds. They are also required to deposit five dollars with the park superintendent as a guarantee that they will leave their camp site in good condition. Should the site need special cleaning the superintendent deducts the cost from the deposit. Portable camp sites are being leased at $10.00 per year rental with privilege of renewal. Ten leases of this character have been made to date.

The following rules and regulations have been adopted and are made a part of all leases:

For Fire Prevention: Campers must not leave fires without knowing they are out. Smokers must not throw matches, cigarettes, or pipe ashes where there is a chance of fire starting.

Camping Parties must secure a permit to camp on park grounds from the park superintendent.

Hunting or Trapping or the carrying or using of fire arms is strictly prohibited.

Trees, Shrubs and Plants shall not be mutilated. The carving or writing on any buildings or rock, and the removal or defacement of signs is prohibited.

Automobile Drivers shall not run their cars above 15 miles per hour at any time on park roads.

The Prohibition relating to intoxicating liquors on the grounds must be strictly observed by campers and cottagers.

Boats and Other Property of campers and cottagers must not be tampered with, and glass of any kind, tin cans, or other rubbish that might injure bathers must not be thrown into the lake.

Rowdyism in deportment and profane language will not be tolerated on the grounds. Violaters of this rule will be expelled from the grounds and prosecution will follow if persisted in.

Persons Who Violate any of the Foregoing Rules will be summarily removed from the park and be subject to the laws as provided. The park

VIRGIN FOREST OF MIXED HARDWOODS NEAR EAGLE BLUFF
PENINSULA STATE PARK

superintendent is hereby authorized and directed to enforce these rules and regulations and all provisions of the law governing the state parks.

The Active Coöperation of all campers and cottagers is earnestly asked in all matters concerning the welfare of the parks for the preservation of order and proper sanitation."

The total expenditures on the six parks during the fiscal year 1915–16 were as follows:

Devil's Lake Park	$4,028.44
Peninsula Park	3,824.24
Interstate Park	1,776.65
Marquette Park	1,378.72
Brule Park	342.88
Cushing Park	295.00

Value of Buildings on State Parks.

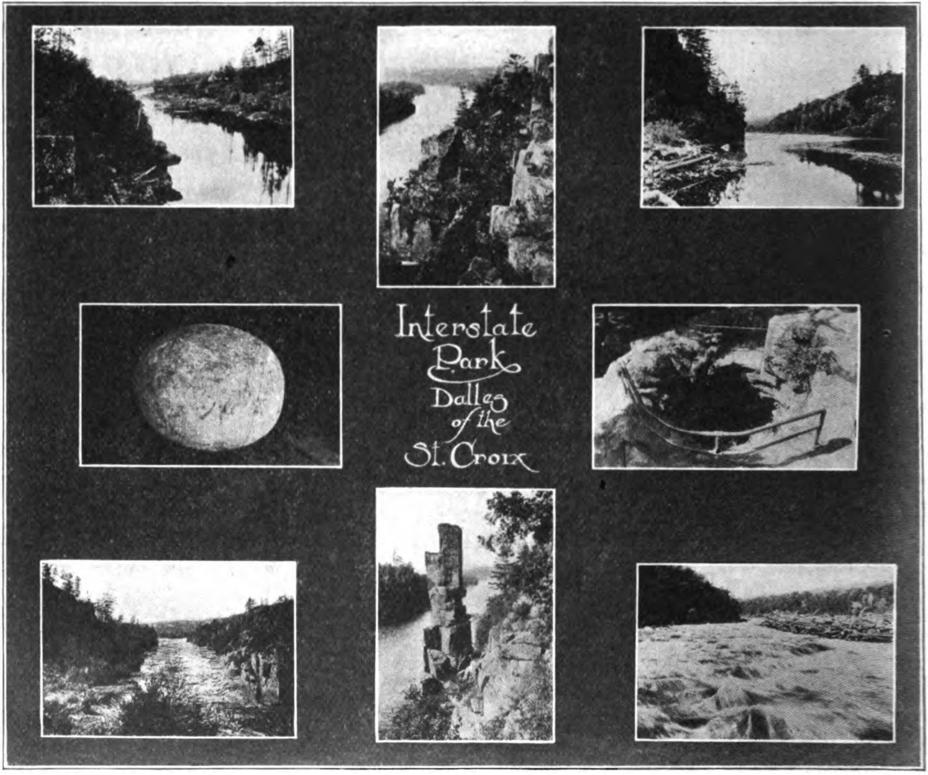
Devil's Lake Park	$20,350.00
Peninsula Park (buildings)	15,634.00
(towers, 2)	1,620.00
Marquette Park	1,000.00
Interstate Park	400.00
Total	$39,000.00

PROPOSED GIFT OF TREMPEALEAU MOUNTAIN.

This commission takes great pleasure in announcing that, through the great generosity and public spirited act of Mr. John A. Latsch of Winona, Minnesota, Trempealeau Mountain, comprising almost 500 acres, both scenically and historically one of the most interesting points in the upper Mississippi, will soon be donated to the state as a public park. Dr. E. D. Pierce of Trempealeau and other local historians have been endeavoring to secure this property for the public, and through their efforts Mr. Latsch became interested and decided to purchase it and donate it to the county or state. Dr. Pierce and Mr. Latsch at first desired to present this property to the State Historical Society, but were persuaded by Mr. M. M. Quaife, Superintendent of the Society to turn it over to the state as an addition to the State Park System, since the Historical Society is not organized to administer such a trust.

Trempealeau Mountain was called by the Winnebagos, "Hay-nee-ah-chah" or "Soaking Mountain," and the French voyageurs adopted the native term, but in their own language, and the present term is an anglicized corruption of the latter part of the French designation, and no one who has ever voyaged on the upper Mississippi and has seen from the deck of his boat the lofty crest of the noble peak towering above him as if from midstream, can question the appropriateness of the name.

Father Louis Hennepin discovered Trempealeau Mountain in 1680 and five years later Nicholas Perrot and party going to build a fur trading post among the Sioux Indians, was overtaken by bad weather near this site, and took up their quarters at the foot of the mountain, where they remained until the spring of 1686. Three years later they planted the



LABELED ON PICTURE

arms of Louis XIV and in his name took possession of all the land drained by the waters of the Upper Mississippi. In 1731 a fort was built on the site of Perrot's wintering post by a representative of the French Government.

In recent years the State Historical Society and interested local historians have succeeded in locating the site of Perrot's post of 1685, and Linctot's fort of 1731–36. Several hearthstones were uncovered, one with a rude chimney; a blacksmith forge was found, and many other relics of white occupancy. Thus, of the ten or more forts built by the French in Wisconsin, to Trempealeau belongs the distinction of possessing the only ones whose ruins have been certainly identified.

Before long, under the auspices of the State Historical Society, the mountain will be formally tendered to the State, to constitute forever one of the most interesting spots embraced in Wisconsin's splendid system of State Parks.

INTERSTATE PARK.

This park is owned jointly by Wisconsin and Minnesota, as it lies on both sides of the St. Croix river, which at that point, forms the boundary between the two states. It contains 730 acres, of which 580 acres are owned by Wisconsin and 150 by Minnesota. This park is complete.

The Dalles of the St. Croix are the chief features of the park. The river flows through a narrow gorge in the Keweenawan trap rock, which at one point rises to a height of more than 200 feet. There are several picturesque rock formations, the most interesting of which are "The Old Man of the Dalles" a remarkable profile stone face on the Wisconsin shore, and the "Devil's Chair," a column of rock on the Minnesota side. A series of pot holes, varying in diameter from one to six feet, and in depth from one to eighty feet, are found on the banks, chiefly on the west side of the river. These pot-holes, now to be seen high above the river, were worked into the solid rock by the grinding action of the spherical boulders, many of which still remain in them.

Professor Martin, in "Physical Geography of Wisconsin," says:

> "Before the Glacial Period the upper St. Croix had a course to the West in Minnesota. Its middle course in the St. Croix Dalles is postglacial. Before the Glacial Period its lower course was occupied by a short stream, whose headwaters were the Apple River, tributary of today. The St. Croix River was the outlet of two of the glacial lakes in the Lake Superior basin, north of Stillwater, Minnesota, the valley is fairly wide, with gently sloping terraced sides" * * *.
>
> "The rock ledges (at the Dalles) are ancient lava flows, of which seven may be identified, rising like giant steps above the river. The lava or trap, is well-jointed, so that there are vertical precipices and isolated crags along the St. Croix river."

The general improvement work on the park has been under the supervision of a park superintendent. Much of the wooded area has been cleared of underbrush, trails and bridges have been repaired, and the dead and down trees have been cut, from which over 43,000 feet of lumber was

LOOKOUT POINT. MARQUETTE STATE PARK

sawed. A portion of the lumber has been used in building a tool house near the ball ground which will also afford a dressing room for the players.

The baseball ground has been developed on the upper end of the park, midway between the towns of St. Croix Falls and Taylor's Falls, the towns subscribing $423.00 and $119.00, respectively, for the work. The time of the superintendent in supervising the work was donated by the state, together with other expenses, amounting to $147.00.

During the next two years the road south through the park should be improved to the southern boundary, since it is expected the town of Osceola will continue this road from the park boundary south, making all parts of the park accessible to the public.

Considerable forest planting on the open fields is contemplated during the spring of 1917. A bath house will be erected on Thaxter Lake, which lies entirely within the park.

On the rock bluffs, white and red pine and oak abound. The hills farther back are covered with mixed hardwoods, and the bottom lands are covered with elm, silver maple and hackberry.

MARQUETTE PARK.

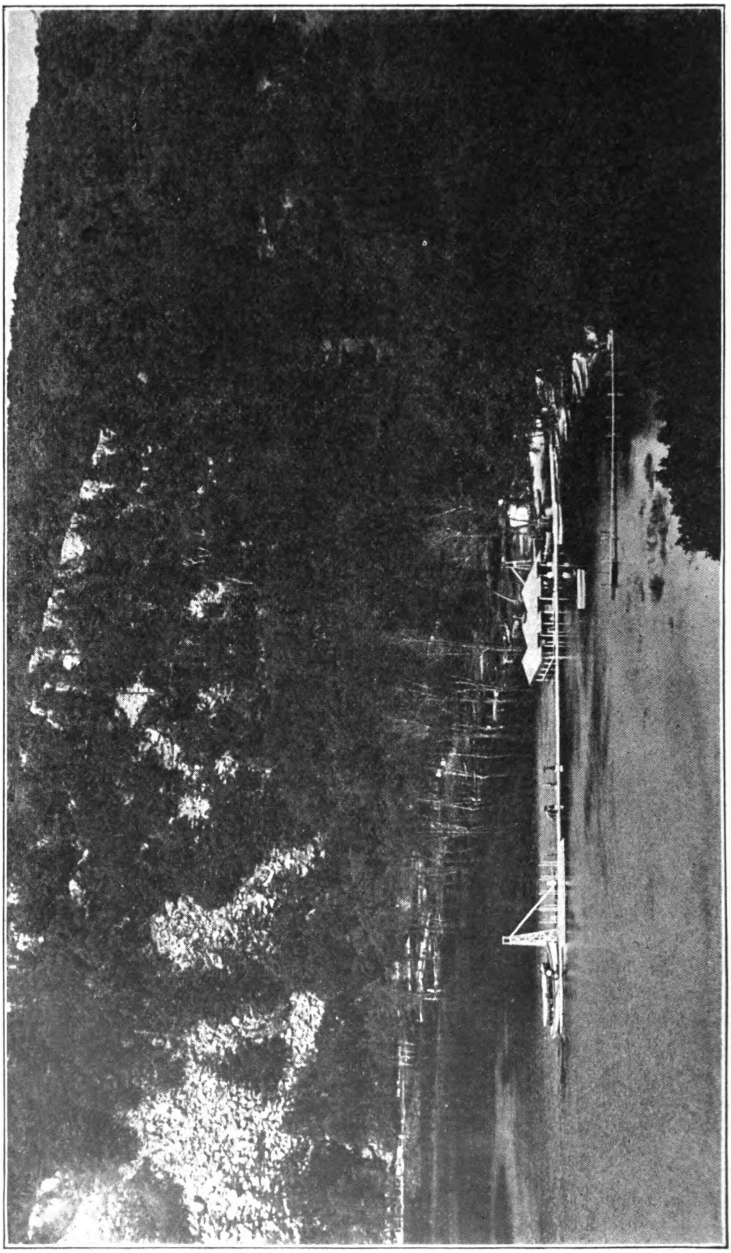
The Marquette State park is located in Grant county in the angle formed by the confluence of the Wisconsin and Mississippi, and includes the bluffs along both rivers. The greater portion of this land was the old Glenn homestead and it was due to the efforts of Senator Robert Glenn that the natural beauties were preserved, as he for a long time had in mind the idea of this area becoming a great natural playground for the people of future generations. The park is complete and contains 1651 acres. The Military road terminates on the park, the highest point being some 500 feet above the Mississippi, and 1180 feet above sea level.

None of the natural beauties of the park have been destroyed, although some of the upland has been cleared, thus giving a variety of scenery. The site of the first fur trading post established on the upper Mississippi is on the park. Above the narrow crest of Sentinel Ridge, overlooking the Mississippi, is located one of the finest groups of Indian mounds in this section of the state. This system is over one-half mile in length, and is known as the "Procession of Mounds" consisting of 14 conical, 13 linear and a single effigy mound. These mounds were marked by the Wisconsin Archaeological Society in 1911, the tablet bearing this legend,—

"PROCESSION OF MOUNDS"
Length about one-half mile.
Marked by the Wisconsin Archaeological Society
September, 1911.

Effigy mounds of deer and bear, linear, chain and burial mounds are common.

Father Marquette, and his associate, Louis Joliet, the great explorers, discovered the Mississippi river from Point Lookout, on their voyage of discovery in the year 1663. Other points of interest are Sunshine Hill,



WEST BLUFF—DEVIL'S LAKE STATE PARK

Signal Hill, Eagle Eye, Black Hawk Monument, Roll-away, Linden Valley, Winnoshick and Glen Grotto, a brilliantly colored sandstone cave, with water falls tumbling over its sides, making it one of the beauty spots of the park. About 450 acres of the park land have been cleared. The balance is well wooded, consisting of such species as white, red and black oak, basswood, sugar maple, aspen, and white birch on the upland and slope types. In the hollows may be found ash, basswood, slippery elm, black walnut, butternut, mulberry, and honey locust. The bottom land type is composed mainly of silver maple, white elm and river birch.

The many points of interest on the park are being made accessible by the construction of three miles of standard road, which lead to Point Lookout; to Sentinel Ridge, winding in and about several Indian mounds, and down through a long hollow to the Burlington Railroad, where a station will be erected by the railroad company, thus making it possible for pleasure seekers to reach the park in the shortest possible time. Further appropriations should be made to extend the road system to Walnut Eddy on the Wisconsin river, a distance of one and one-fourth miles. Many trails should be laid out, the superintendent's house repaired, fences built and other improvements necessary to the comfort of visitors.

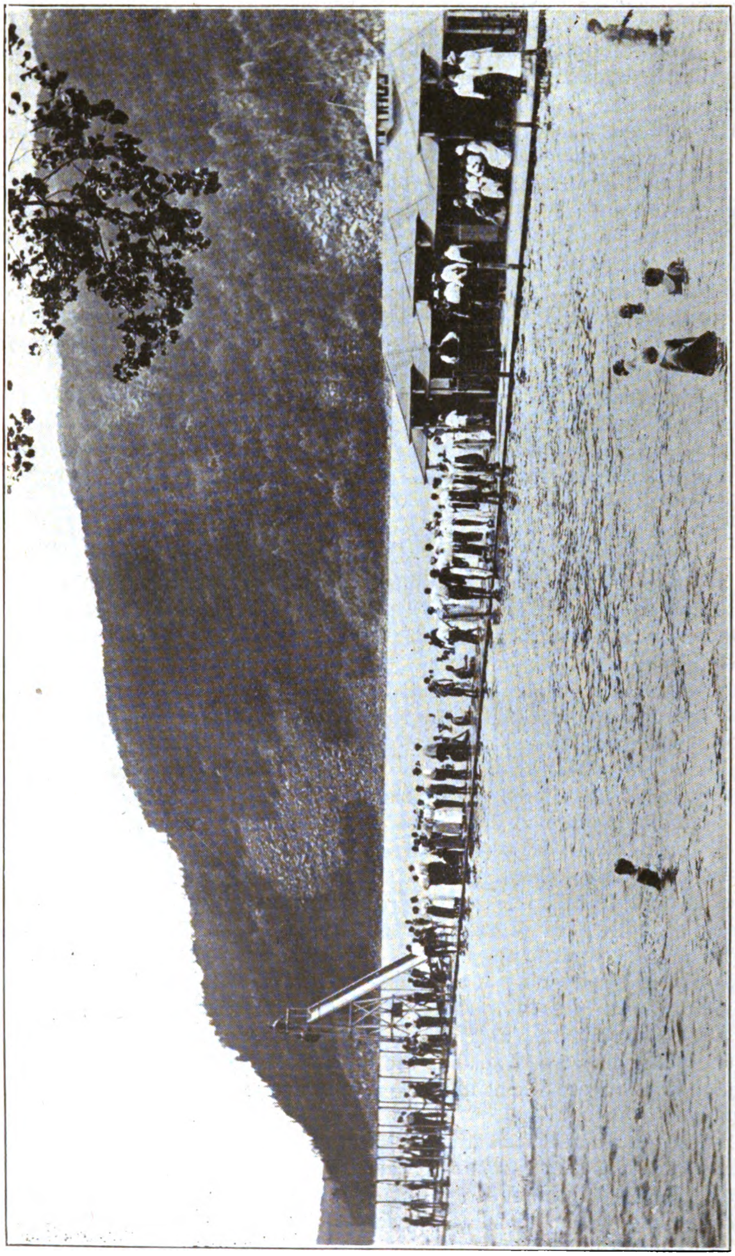
DEVIL'S LAKE PARK.

The Devil's Lake Park contains 1040 acres surrounding the lake, and is the most centrally located of the state parks, being accessible both by rail and automobile from all points. It has long been a playground of the people and the summer hotels have had a large number of guests annually. It is located in Sauk county, near Baraboo. The surface of the lake lies 600 feet below the east bluff, which is itself some 1400 feet above sea level. It is a beautiful sheet of water, without a visible outlet, fed by springs, and surrounded by great crags and bluffs of rock, thrown up by volcanic action of some former age.

The lake is one and one-fourth miles long, one-half mile wide and 43 feet deep, and is enclosed on the east, west and south shores by rugged bluffs of Baraboo quartzite. The north and southeast ends are filled with glacial drift, in fact this glacial drift has formed the lake basin by damming up both ends of the older gorge. The bluffs are without glacial drift, and the limit of the driftless area, is sharply defined. The geology classes of the University of Wisconsin and the University of Chicago spend several weeks in field work on the park and the surrounding country annually. President Van Hise of the University of Wisconsin, one of the most distinguished geologists in the country, has said, "I know of no other region of the state which illustrates so many principles of the science of geology."

There are several interesting rock formations, the most remarkable ones being known as the "Doorway," the "Needle" and "Turk's Head." Some interesting Indian mounds are found on the park, the most striking being an eagle mound on the southeast shore.

The rough topography of the park and the surrounding region prevented clearing, so the percentage of forest area is large, and the native flora and fauna has survived remarkably well.



DEVIL'S LAKE AFFORDS SPLENDID BOATING AND BATHING FACILITIES TO THE GENERAL PUBLIC

The native flora is extremely varied and natural conditions will be maintained so that the botanist will find not only the species, but also the ecological conditions under which they grow. River birch is found along the lake shore, mixed hardwood stands occur on the higher land, large white pines occupy the rocky slopes, and the tops of the bluffs are covered with oak. The chief sports are boating, fishing, swimming and climbing. Excellent sand beaches with a uniform and gradual slope are found at both ends of the lake. Many of the visitors make a practice of climbing some of the bluffs daily, and while the slopes are not nearly high enough to be considered mountains, they are steep and rugged enough to make it extremely interesting if one deviates from the trails, as many do.

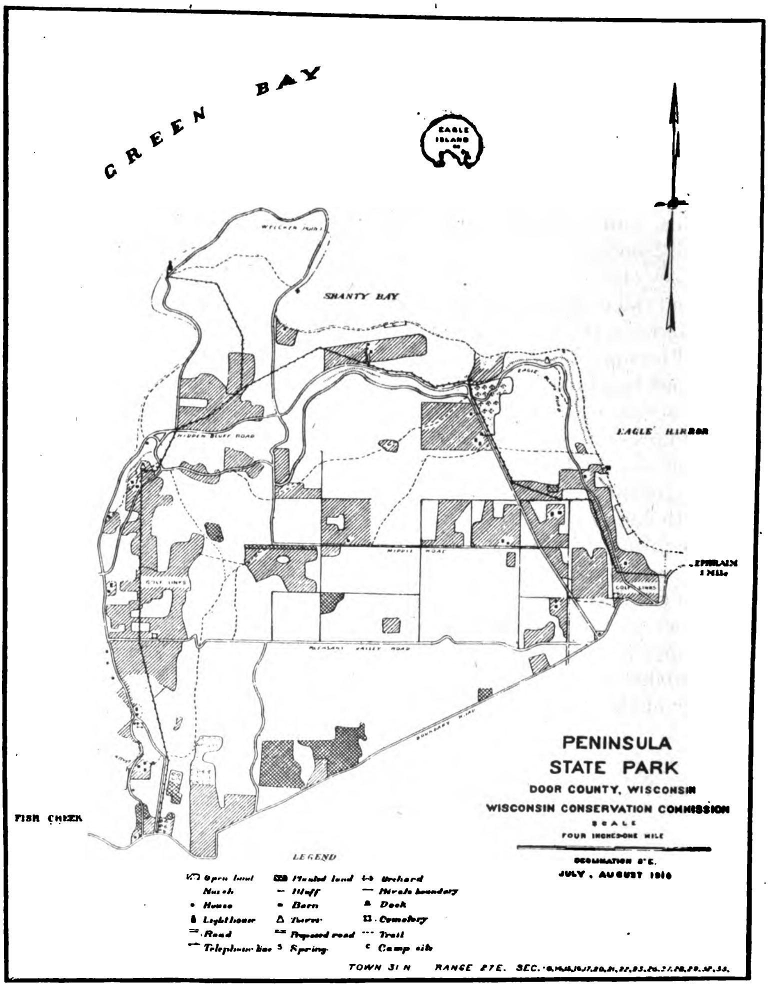
Many permanent improvements are contemplated on the park. Its usefulness as a playground has grown to a wonderful degree in the past two years, and will increase rapidly in the future. The development of roads, the repair of the hotel buildings and cottages, and the construction of sanitary closets, at both ends of the lake, the installation of water systems, and the general improvements of all playgrounds are planned. The new road from the hotel east to the park boundary is practically complete and will become a part of the state highway system, upon the completion of the road from the east park boundary to the old road near Zauft's farm. This new route will make the park easily accessible from the south and east. Plans and estimates of costs of a road around the south end of the lake will be made by engineers of the State Highway Commission. Another project under consideration is the proper location of a road at the north end of the park. This route will also be surveyed with the idea of coöperating with the town and city of Baraboo in selecting the most suitable location. Another matter of the greatest importance is the purchase of the three remaining properties bordering on the lake. One fifteen acre tract at the north end is in process of condemnation. The other two properties should be condemned and purchased. It is recommended that $40,000 be appropriated to purchase these properties and the remainder of the interior holdings within the Peninsula State Park.

PENINSULA PARK.

Peninsula park is the largest of the state parks, containing approximately 3,240 acres, and is located on the Door county peninsula, between Fish Creek and Ephraim. The remaining interior holdings, consisting of woodlands and farms, amount to about 465 acres, and 10 lots and parcels. One forty acre farm has recently been purchased at a cost of $650.00. The state now has under option 160 acres of farm and woodland property, for a price of $6,150.00, which upon the completion of the purchase will leave a balance of about 300 acres and 10 lots and parcels to be added to the park. It is estimated that the remaining interior holdings can be purchased for $14,000.

This land should be added to the state's holdings. The sums available in the park purchase fund will undoubtedly be sufficient to pay for these properties as they are offered for sale in the future.

The park is well timbered. The flora is not extensive, but the forests of white and red pine, hemlock, balsam and hardwoods, are beautiful. Several stands of beech show a forest type that is rather unusual. Dense stands of white cedar are found along the shore, while in some of the fields, juniper and more rarely the shrubby yew (Taxus canadensis) give an effect of formal planting.



GENERAL MAP OF PENINSULA STATE PARK

It is planned to not only make the fullest use of the park as a great pleasure ground, but also to so manage the wooded areas, totaling 2,770 acres, that there will be a sustained yield of forest products. A complete forest working plan has been prepared for the ensuing ten years. The total estimate of the standing timber amounting to 4,812,987 feet on the park is as follows:

Estimate of Timber on Peninsula State Park.

Species	Board Feet	Cords	Posts
Balsam	274,951		
Cedar			27,420
White pine	455,594		
Red pine	283,970		
Hemlock	1,765,520		
*Beech	598,430		
Birch		3,233	
†Maple	894,808		
Basswood	131,840		
Ash	30,164		
Poplar		1,929	
Oak	377,710		
Miscellaneous		489	
Total	4,812,987	5,651	27,420

*Reduced 30% for defect.
†Reduced 20% for defect.

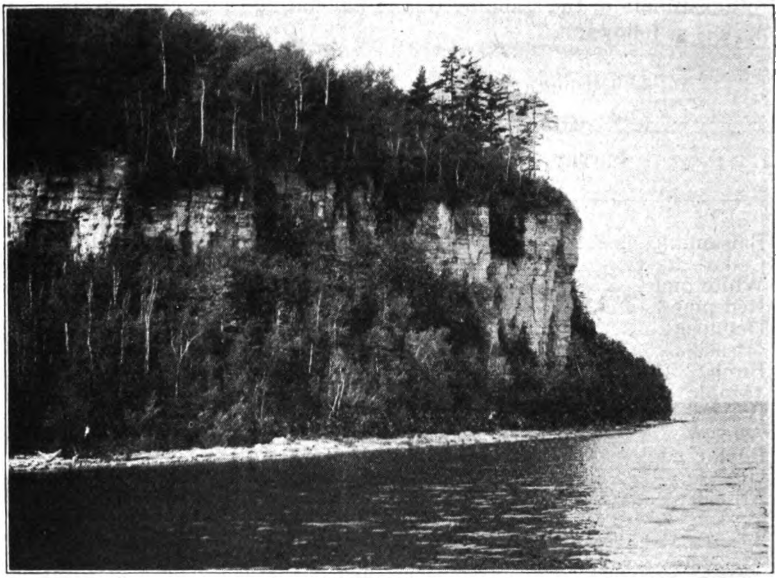
Fifty acres of open fields along the boundary road were planted to coniferous stock of the following species, during the spring of 1916.

White pine	40,250
Red pine	12,000
Scotch pine	10,000
White spruce	4,000
	66,250

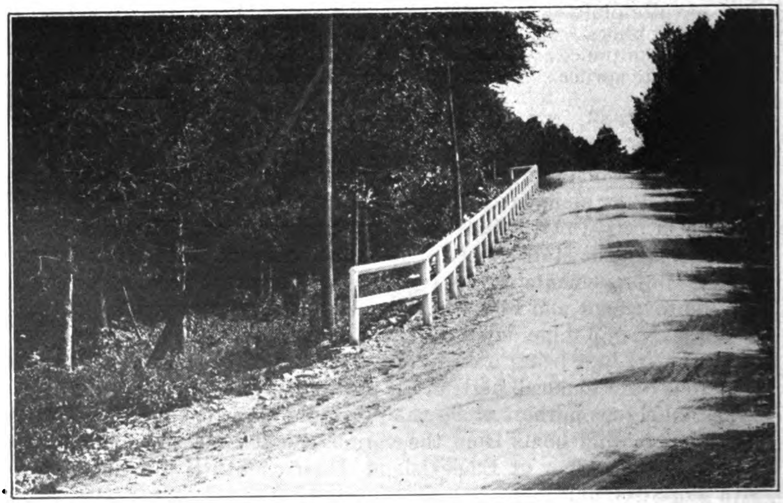
There are remaining some 500 acres of open land suitable for forest planting. It is planned to reforest the entire area, spreading the work out over a period of 10 years, or fifty acres per year. The trees will be supplied from the state nurseries at Trout Lake and Tomahawk Lake.

Many improvements are contemplated. The great need is good roads and improvement and repair of the many cottages now on the park, all of which are in a dilapidated condition. The golf links, on either side of the park, are now being used by the followers of the game. Roads and numerous trails make all parts of the park accessible.

The numerous harbors along the peninsula make sailing or motorboat cruising safe, and boats from the various yacht clubs are often seen at anchor in the harbor at Eagle Island. Door county is a favorite region with motorists, and many cars come to the park each year. The park is reached by motor-stage from Sturgeon Bay or by boat from Marinette. Others come from the lower ports on Lake Michigan on the Goodrich line steamers. Good hotel accommodations are found at Fish Creek



EAGLE BLUFF. PENINSULA STATE PARK



MACADAM ROAD. BOUNDARY OF PENINSULA STATE PARK and Ephraim, both villages adjoining the park. Camp sites may be had by applying to the superintendent, and several unfurnished houses may be leased for the season.

Two lookout towers to aid in detecting forest fires have been erected on Sven's Bluff and Eagle Bluff, which are connected by telephone with the superintendent's residence and the local exchange. As these towers are built with railed stairways and landings, they may be climbed safely by anyone, and visitors to the park find the views well worth the climb. From both towers, buildings in Marinette, eighteen miles across the bay, may be seen on clear mornings with the naked eye.

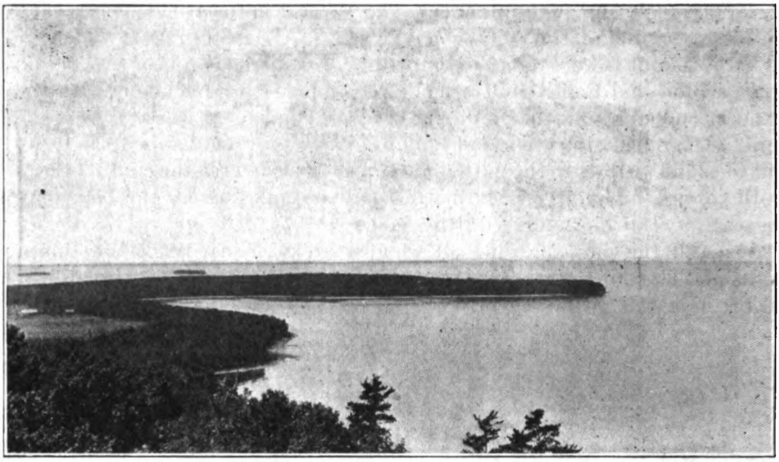
Maps of the park showing all wooded areas, fields, roads, buildings, trails and lookout towers, are now being prepared and will be available at all of the hotels in the region.

BRULE PARK.

A part of the Nebagamon Lumber Company grant of 4,321 acres of land along the Brule river, a famous trout stream, in Douglas county, has been set aside as a state park and is being managed as such. It is located between the Northern Pacific and the Duluth, South Shore and Atlantic railroads and is within easy walking distance from the Brule and Winneboujou stations. Twenty-seven lots have been laid out along either side of the river in Section 23. These cottage sites will be leased either for portable or permanent buildings for periods of from one to twenty years, as desired. Approximately three-quarters of a mile of new road was opened up adjacent to the lots on the east side of the river, which connects on the west end with the proposed road through the recently platted Heimbaugh and Spring addition. When this road is completed, it will, in all probability, be the main road between Brule and Winneboujou. Because there is but little timber growth on the lands, the greater part of the river lots, as well as some fifty acres of hill land on the west side of the river, was planted to coniferous forest trees to the amount of 72,000. The needed protection from fire has been given the plantations by opening the old logging railroad grades, which makes all parts of the planted areas accessible.

CUSHING MEMORIAL PARK.

The Cushing Memorial Park is located about a half mile west of Delafield, Waukesha county, on the site of the old Cushing homestead. It comprises about eight acres, one-fourth of which is low and marshy, along the Bark river, the remaining portion rising slowly in a dry even slope. At the crest of this slope is located the shaft erected in memory of the "Three Wisconsin Cushings," while on the site of the old farm home, no traces of which remain, but in which two of the boys were born, a large stone marker has been placed.



LIGHTHOUSE POINT AND SHANTY BAY FROM LOOKOUT TOWER.
PENINSULA STATE PARK

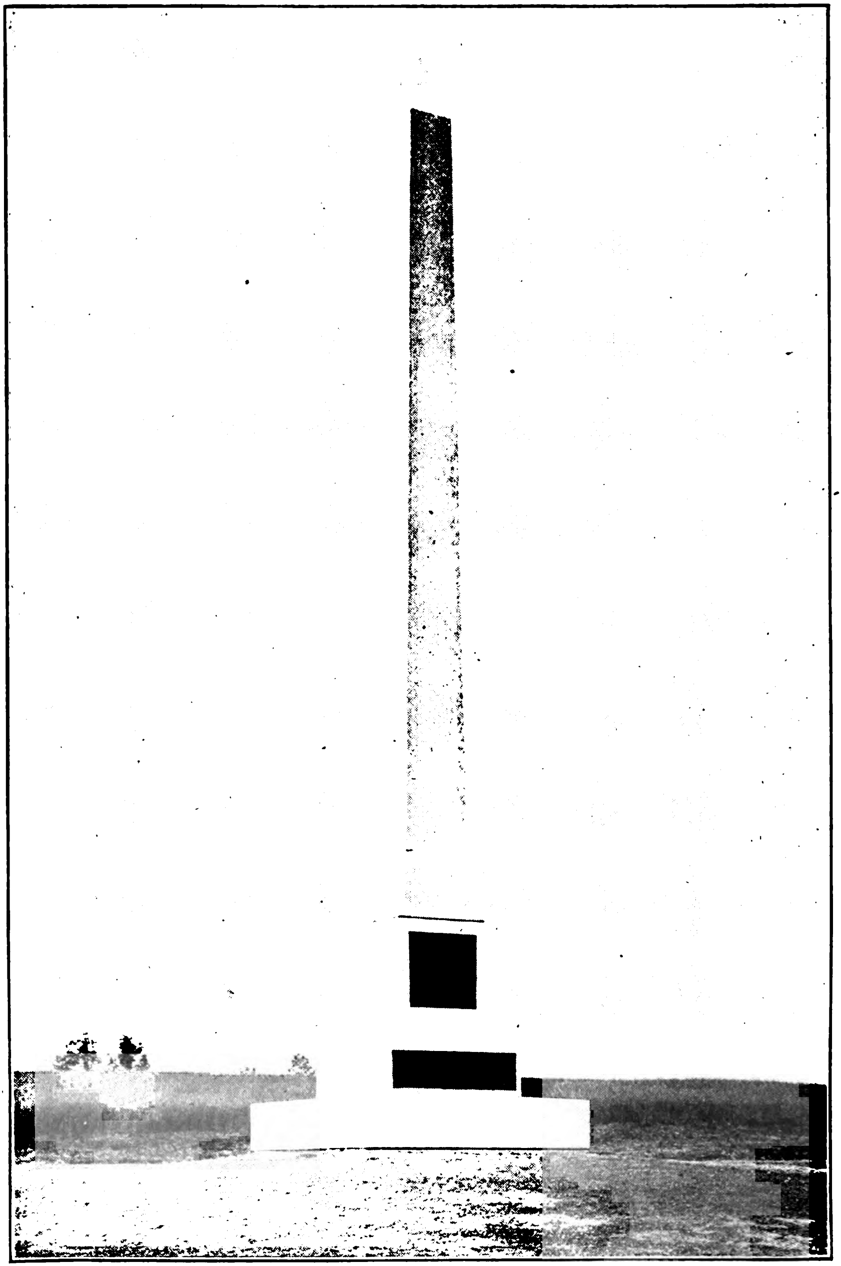
AN EFFORT AT "FORMAL" PLANTING BY NATURE
PENINSULA STATE PARK

The three Cushings, William B., Alonzo H., and Howard, won unusual distinction for bravery during the days of the rebellion. William B., practically single handed, sank the ironclad ram Albemarle, which has been pronounced by Col. Roosevelt as one of the most daring deeds on the pages of naval history. Alonzo H., fell at the crest of the battle of Gettysburg, after being shot four times. He did much to turn Pickett's charge and to win the day. Howard B. the third brother, was in command of a troop fighting the Apaches in the southwest, and lost his life in a hand to hand conflict with the Indians. No other Wisconsin family perhaps, produced such a trio of brave fighters.

The Waukesha County Historical Society was chiefly instrumental in the creation of this park. The land was donated by various citizens to the Society, who accepted it in trust. Later when the erection of an appropriate monument was considered, and because the funds of the society were insufficient to erect a suitable monument, the aid of the state was solicited. The legislature of 1911 authorized the Governor to coöperate with the Historical Society in the erection of a monument to mark the birth place of the Cushings. As a result, $5,000 was appropriated and a very imposing and beautiful obelisk was erected in their honor. This shaft was dedicated May 31, 1915. The unveiling was done by Miss Catherine Cushing, the daughter of William B. Cushing, who sank the Albemarle.

In 1915 the park was turned over to the state and was placed in the regular state park system which is under the administration of the Conservation Commission.

The foreman of the fish hatchery at Delafield has direct charge of the management of the park. A road has been constructed into the grounds and around the monument, the funds being largely subscribed by Delafield and Waukesha citizens. The Conservation Commission has beautified the site by the setting out of trees and shrubs. It is contemplated to fence the park in a suitable manner in the near future, to continue the planting of trees and shrubs and to make other necessary improvements, which will preserve and enhance its beauty. The expense to the state will be very small for this work, and is warranted by the use the general public will find in this park and the high purpose for which it was created.



CUSHING MEMORIAL MONUMENT

STATE FOREST NURSERIES.

By C. L. HARRINGTON.

The state forest nurseries were established for two reasons:

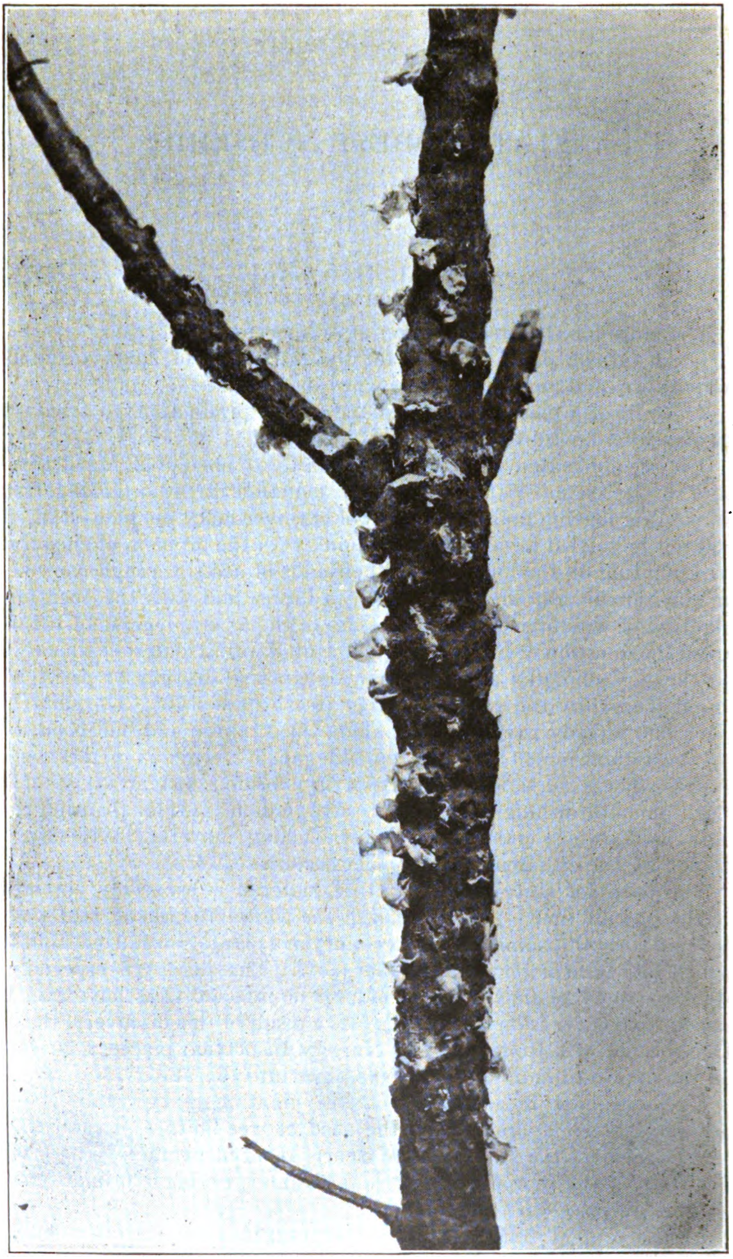
1. To furnish plant material for the restocking of lands unsuited for agriculture, and park properties owned by the state.
2. To furnish planting stock, at the cost of production, to private land owners who desired to reforest their holdings.

The second reason was adopted primarily to encourage forest tree culture in the state. With the gradual depletion of the original forests in Wisconsin, leaving millions of acres of cut-over land, the poorest of which will not be settled for a century or more; with the problem of encouraging tree planting on the hundreds of thousands of acres of rough, very stony, or non-agricultural lands on Wisconsin farms, and with the need for the planting of windbreaks or shelter belts in the prairie regions of the state, arose the question of providing a source of planting material, which would be cheap, acclimated and free from destructive diseases or pests, which might jeopardize the growth of other trees in the state. The same questions had already risen in states along the Atlantic and had been solved by the establishment of forest nurseries in over twenty of the northern states. These nurseries have grown to enormous extent, those of New York alone furnishing from three to five million trees for planting to private land owners annually. In establishing nurseries, Wisconsin was guided by the experience of the older eastern states.

The need for state-grown planting material is especially emphasized at the present time. An outbreak of the white pine blister rust was discovered early this summer in Polk county in a plantation started from stock which had been imported from Germany. This disease is especially destructive to white pine, young or old, for no infected trees have ever been known to recover from its ravages. As a result of this discovery, the State Department of Entomology and Nursery Inspection placed a quarantine on the importation of all five needle pines into this state.

The sentiment regarding forest tree planting in the state is yearly becoming more favorable. As the need of tree culture in the economic development of the state is more clearly realized by the average citizen, the work of the reproduction of timber stands on lands primarily suited for this purpose will increase.

At the present time two forest tree nurseries are maintained by the State Conservation Commission, one located at Trout lake, which embraces about seven acres, and the other at Tomahawk lake, includes about four acres. The Trout lake nursery is primarily suited for the development of



YOUNG WHITE PINE TREE ATTACKED BY BLISTER RUST. NOTE THE FRUITING BODIES coniferous species, being located on a sandy loam soil. The Tomahawk lake site is composed of heavier soil and is intended more for the raising of the broad leaved trees. Each nursery is equipped with the necessary fences, roads, shade frames, tools and watering facilities to properly care for and protect the growing seedlings and transplants to all times of the year.

The nursery work under the administration of the Conservation Commission has experienced a healthy growth. During the spring of 1916, 1,501,000 two-year seedlings were transplanted at an average cost of 85 cts. per thousand. These transplants were composed of the following species:

NUMBER OF TRANSPLANTS

	Trout Lake Nursery.	Tomahawk Lake Nurs.
White pine	220,000	222,600
Red pine	648,000	220,400
Scotch pine	88,000	
Norway spruce	102,000	
	1,058,000	443,000

SEED BEDS WERE SOWN AS FOLLOWS:

	Trout Lake Nursery.	Tomahawk Lake Nurs.
White pine	50	20
Red pine	20	
Scotch pine	66	10
White spruce	6	8
Norway spruce	15	10
White ash		3
Basswood		2
	157	53

The results of this work were fairly satisfactory. The extreme dry spell in July caused the loss of some of the transplants, but the heaviest damage was done by the June beetle grubs. These occurred in unusual numbers. They work underground, chewing off the roots of the trees, thus causing them to wither and die. They are especially destructive to transplants. At present no effective way has been discovered to combat them. In ordinary years the damage from this cause is light, but during years when the grubs are unusually numerous, their work is very destructive and this is especially true on new land.

Except for the practical failure of the Scotch pine seed beds, due to the long storage to which the seed had been subjected on account of the war, the sowing of 1916 was of average success. Very good stands of white and red pine and Norway spruce were obtained.

STOCK DISTRIBUTION.

The distribution of nursery stock throughout the state was especially noteworthy during 1916. The following tables give complete data relative to these shipments. Especial attention is called to the steady increase in the shipments to private parties.

SHIPMENTS OF PLANTING STOCK FROM STATE NURSERIES (Spring of 1916).

Order No.	Consignee	Address	From Trout Lake												From Tomahawk Lake				ORDER TOTAL
			White Pine			Norway Pine			Scotch Pine		Norway Spruce			Total	White Pine		Wt. Sp	Total	
			2-2	3-0	2-0	2-2	2-1	2-0	2-2	2-0	2-2	2-1	2-0		2-2		2-2		
	Peninsula Park	Fish Creek	3,000				12,000		10,000					25,000	37,250		4,000	41,250	66,250
	Wild Rose Hatchery	Wild Rose	2,200				2,000		2,200		200			6,600			200	200	6,800
	Brule Planting	Brule					36,000		18,000					54,000	18,000			18,000	72,000
	Headquarters					1,250			15,250					16,500					16,500
	Devil's Lake Park	Devils Lake	3,000			500			1,000		500			5,000					5,000
	Woodruff Fish Hatch	Woodruff	500			1,250			750					2,500	2,000		100	2,100	4,600
	E. Wilson	Gordon					36,000			12,000				48,000	12,000			12,000	60,000
S161	Theo. Mentges	Withee	1,000								100			1,100					1,100
S162	Percy Ap Roberts	River Falls	200						100					300					300
S163	Wm. A. Warner	Whitehall	100			100			100		100			400					400
S164	W. F. Kern	Waukesha		500					500			500		1,500					1,500
S165	C. Scheckler	Racine	500								500			1,000					1,000
S166	Geo. H. Conrow	Whitehall	500						500		1,000			2,000					2,000
S167	E. A. Ross	Greenwood	200								200			400					400
S168	J. H. Fiebing	Elkhart Lake	100			100			100					300					300
S169	Harry McClurg	Viroqua									300			300					300
S1610	Mil. Co. Park Com.	Milwaukee	1,000			1,000			1,000		1,000			4,000					4,000
S1611	A. Kazmeier	Kiel	400											400					400
S1612	Geo. F. Comings	Eau Claire		350								1,000		1,350					1,350
S1613	Henry A. Price	Withee	200								300		500	1,000					1,000
S1614	Lewis J. Lee	De Forest									500			500					500
S1615	Rusk Farm Co.	Chetek	4,000		500				1,000		2,000			7,500					7,500
S1616	Faast Land Co.	Conrath	4,000		500				1,000		2,000			7,500					7,500
S1617	L. D. Moses	Ogdensburg	250											250					250
S1618	J. R. Kelton	Poynette							500		500			1,000					1,000
S1619	F. A. Aust	Madison	3,000			2,000						500		5,500			500	500	6,000
S1620	J. A. Schmidt	Ladysmith	500						300					800			200	200	1,000
S1621	Clayton Lurvey	Dousman	300		100	100						100	100	700					700
S1622	W. K. Coffin	Eau Claire	2,000	1,000								500		3,500			500	500	4,000
S1623	Ben Meier	Coon Valley	200			500						300		1,000					1,000

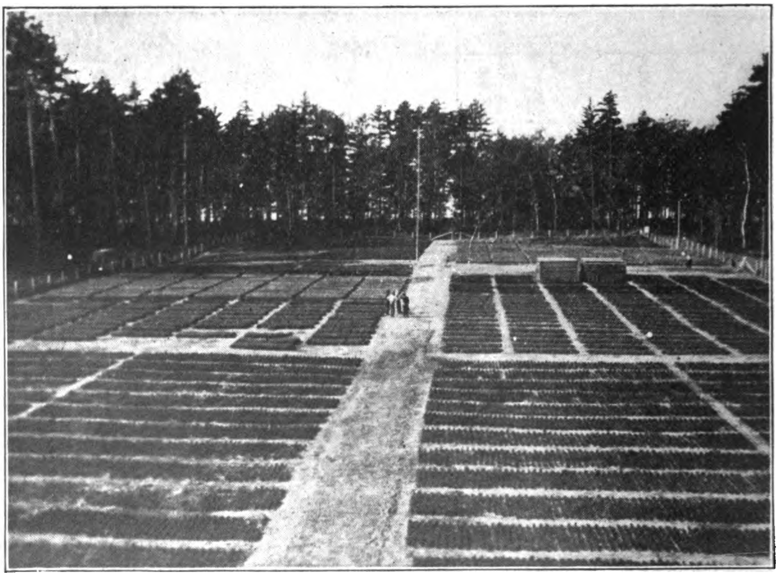
S1624	J. Woelfel	Hayton	100			100								200					200
S1625	P. A. G. Lee	Deerfield	100						100			100		300					300
S1626	F. A. Aust	Madison	400									300		700					700
S1627	Philip Schottler	Withee	500								500			1,000					1,000
S1628	J. H. Nye	Minong				500								500					500
S1629	F. G. Van Horn	Hixton	100											100					100
S1630	E. Alton	Sayner	50						25		25			100					100
S1631	Faast Land Co.	Conrath					2,000							2,000					2,000
S1632	Fred Miles	Deerfield	50						25		25			100					100
S1633	L. J. Pickarts	So. Madison	200								200			400					400
S1634	A. T. Zieman	Randolph	250			250								500					500
	Ed. Gabe	Sayner	25			25			25		25			100					100
	H. Freund	Oxley	100			125			25		50			300					300
	E. M. Weaver	Woodruff	100			100			100		100			400					400
Total Shipments, Spring of 1916			29,125	1,850	1,100	7,900	88,000		52,600	12,000	10,125	3,300	600	206,600	69,250		5,500	74,750	281,350

Private shipments (1914) — 20,200
Private shipments (1915) — 77,350
Private shipments (1916) — 110,200
(2-2)—2 years in seedbed and 2 years in transplant bed.
NOTE: 40,000 conifers were planted on state lands in the fall of 1916.

1916 State shipments..........171,150

PORTION OF NURSERY. TROUT LAKE

Note: Original pine forest in the middle and left background; new plantations in the right background.



A PORTION OF THE STATE FOREST NURSERY. TROUT LAKE

The following table gives the inventory of the growing stock in the state nursery on July 1, 1916:

STATE NURSERY INVENTORY

July 1, 1916.

Trout Lake.

Species	Number	Years in		Source of Seed	Condition	1917 price per M	Value
		Seed Bed	Trsp. Bed				
White Pine	227,305	2	2	Collected 1911	6″ — 15″ tall. Good.	$5.00	$1,136.53
White Pine	220,000	2	1		2″ — 5″ tall. Good.	4.00	880.00
White Pine	200,000	4	0		4″ — 10″ tall. Good.	3.00	600.00
White Pine	320,000	3	0		2″ — 6″ tall. Good.	2.50	800.00
Norway Pine	403,270	2	2	NE For. Co. 1912	4″ — 12″ tall. Exc.	5.00	2,016.35
Norway Pine	648,000	2	1	NE For. Co. 1912	2″ — 6″ tall. Good.	4.00	2,592.00
Norway Pine	100,000	3	0	NE For. Co. 1912	2″ — 8″ tall. Exc.	2.50	250.00
Scotch Pine	800	2	3	D. Hill (Ger.)	12″ — 24″ tall. Exc.	5.00	4.00
Scotch Pine	88,000	2	1	D. Hill (Ger.)	3″ — 8″ tall. Good.	4.00	352.00
Scotch Pine	50,000	3	0	D. Hill (Ger.)	2″ — 8″ tall. Exc.	2.50	125.00
Norway Spruce	2,000	2	2	D. Hill (Ger.)	3″ — 6″ tall. Exc.	5.00	10.00
Norway Spruce	102,000	2	1	D. Hill (Ger.)	1″ — 3″ tall. Fair.	4.00	408.00
Austrian Pine	10,000	3	0		5″ — 9″ tall. Good.	2.50	25.00
Col. Blue Spruce	23,000	2	2	D. Hill & Co.	3″ — 7″ tall. Good.	5.00	115.00
Sitka Spruce	500	4	0		3″ — 12″ tall. Good.	3.00	1.50
Douglas fir	16,000	3	0		2″ — 3″ tall. Fair.	2.50	40.00
White Cedar	10,000	4	0		1″ — 7″ tall. Fair.	3.00	30.00
Totals	2,420,875						$9,385.38

Tomahawk Lake.

Species	Number	Seed Bed	Trsp. Bed	Source of Seed	Condition	1917 price per M	Value
White Pine	31,000	2	3		7″ — 15″ tall. Good.	$6.00	$ 186.00
White Pine	222,600	2	1		2″ — 16″ tall. Good.	4.00	890.40
Norway Pine	220,400	2	1		2″ — 6″ tall. Good.	4.00	881.60
White Spruce	4,300	2	3		4″ — 12″ tall. Good.	6.00	25.80
Totals	478,000						$1,983.80

The prospects for a reasonable expansion of the activities in the state nurseries during 1917 are encouraging. Inquires from various parts of the state indicate that a good demand for planting material may be expected. Plans are under way for the better handling of all tree shipments and for transplanting and seeding. The Wisconsin forest nurseries should experience the same healthy growth during the coming five years that has characterized the state nurseries in the east, and particularly the New York nurseries.

FOREST PLANTING.

During 1916 approximately 211,000 conifers were planted on state owned lands, while 110,200 plants were furnished private parties, at cost, for planting in the state. The main planting activities on the part of the state, were confined to the State Park lands. At headquarters camp, in the vicinity of Trout lake, about 15 acres were planted to mixed pines during the spring season, while about 35 acres were planted in the fall. These were in the nature of experimental plantings. The planting work in the State Parks was carried forward very energetically, and exceptionally good results were obtained.

PLANTING CREW AT WORK. TROUT LAKE

Note: Cost of planting this type of land will average about $800 including the cost of the planting stock.

The weather conditions during the planting season were very favorable. The days were cool and considerable rain fell.

The following data gives the number of trees planted on lands owned by the state in 1916.

Trout Lake (Headquarters)	
Spring Planting	16,500
Fall Planting	40,000
Peninsula State Park	66,250
Brule River State Park	72,000
Devil's Lake State Park	5,000
Wild Rose Fish Hatchery	6,800
Woodruff Fish Hatchery	4,600
	211,150

The following table shows the amount of stock shipped for planting to private land owners in the state, tabulated by counties, since shipments were started from the state nurseries:

TREES SHIPPED TO PRIVATE LAND OWNERS—BY COUNTIES.

County	1914	1915	1916	Total
Barron			7,500	7,500
Calumet			600	600
Clark			3,500	3,500
Columbia			1,000	1,000
Dane			8,000	8,000
Dodge			500	500
Douglas	1,000	51,000	60,000	112,000
Eau Claire			5,350	5,350
Florence	6,000	3,000		9,000
Jackson			100	100
Lafayette		1,000		1,000
Milwaukee			4,000	4,000
Oneida		450	400	850
Pierce		300	300	600
Portage		3,200		3,200
Price		3,400		3,400
Racine			1,000	1,000
Trempealeau	10,000		2,400	12,400
Sheboygan		14,000	300	14,300
Vernon			1,300	1,300
Vilas	500	1,000	500	2,000
Rusk			10,500	10,500
Washburn	1,400		500	1,900
Washington	1,300			1,300
Waupaca			250	250
Waukesha			2,200	2,200
	20,200	77,350	100,200	207,850

The following table gives the total acreage planted on state owned lands:

	Acres
Star Lake	136
Trout Lake	412
Rest Lake	93
Plum Lake	129
Muskalonge Lake	45
Peninsula Park	50
Devil's Lake Park	4
Brule River Park	75
Wild Rose Fish Hatchery	6
Woodruff Fish Hatchery	4
Tomahawk Lake	1
	955

The success of the plantings may be judged by the following percentage of living trees at the end of the first season's growth, based on actual counts:

	Per cent Surviving.
Star Lake	83
Trout Lake	75
Rest Lake	82
Plum Lake	80
Muskalonge Lake	78
Peninsula Park	94
Devil's Lake Park	40
Brule River Park	60
Wild Rose Fish Hatchery	80
Woodruff Fish Hatchery	85
Tomahawk Lake	85

Up to the present time, the conifers and especially the white and red pines and Norway spruce have been advocated for general planting in the state. The Commission has deemed it advisable to enlarge on this policy so as to include the best broad-leaved trees. From the standpoints of beauty, rapidity of growth and commercial value, the basswood, red oak and white ash are considered to be the best species, and these will be grown in the nurseries. These trees will be ready for distribution during the spring of 1918. They are of particular value for planting in the hardwood belt in the southern part of the state, but also are very well suited to the heavier soils in the northern counties.

NORWAY SPRUCE PLANTATION 18 YEARS OF AGE

Forest tree planting on the part of private land owners is constantly encouraged by the Conservation Commission. In order to stimulate these activities planting plans are prepared for land owners, and thrifty planting stock is supplied from the state nurseries at cost. This cooperative effort to encourage tree culture in the state has met with a reasonable response from land owners, as the sales of planting stock will verify. It is safe to predict that this opportunity offered by the Commission will be taken advantage of in an enlarged way in the future. The order blank adopted by the Commission, and the 1917 price list for planting stock follows:

WISCONSIN CONSERVATION COMMISSION
Madison, Wis.

Price List of Planting Stock

Gentlemen:

The undersigned hereby applies for the following number and kinds of trees for planting in the town of..

County of.., State of Wisconsin.

No order granted for less than 100 trees. Extra charge of 50 cts. per order will be made on lots of less than 1000. Prices are F. O.B. at Trout Lake or Tomahawk Lake. You will be notified if supply of certain stock is exhausted on receipt of your order. Please send full purchase price with all orders.

Amount of Remittance: $........................

Species	Number of trees desired	Price per M.	Age (Years)	Height inches	Cost
White Pine Seedlings..................	....	$2.00	2	2–6	....
White Pine Seedlings..................	....	2.50	3	4–10	....
White Pine Transplants............	....	5.00	4	6–15	....
White Pine Transplants............	....	4.00	3	3–8	....
Red Pine Seedlings*..................	....	2.50	3	4–10	....
Red Pine Transplants...............	....	4.00	3	5–10	....
Red Pine Transplants...............	....	5.00	4	6–14	....
Scotch Pine Seedlings...............	....	2.50	3	4–8	....
Scotch Pine Transplants...........	....	4.00	3	5–10	....
Austrian Pine Seedlings............	....	2.50	3	5–9	....
Norway Spruce Transplants......	....	5.00	4	3–8	....
White Spruce Transplants........	....	5.00	4	4–12	....
Col. Blue Spruce Trspts............	....	5.00	4	3–7	....
Douglas Fir Seedlings...............	....	2.50	3	2–4	....
White Cedar Seedlings..............	....	3.00	4	2–8	....
Total..	....	....	....	....	....

*Another name for Norway Pine

Ship to.. Ship by { Freight / Express / Parcel Post }

Name..

Packed by...

Address..

Date Shipped...............................

Exp. Office..

Description of Land to be Planted

Topography..Kind of soil.................................

Original growth...

Previous use of land...

Remarks...

Date Rec'd....................................... Tree Order No....................................

EXTENT, VALUE AND USE OF WISCONSIN WOODLOTS.

By C. L. HARRINGTON.

The real importance, extent or possibilities of the farm woodlots in Wisconsin are but little appreciated by the average citizen of the State. This perhaps is the chief reason why the average farm woodlot is mismanaged. A woodlot properly located and cared for is an essential part of the well-managed farm. It is highly important that this part of the farm should receive its proper share of attention in order that the benefits arising from its presence may be realized to their fullest extent. These benefits are of material importance to every citizen and to the general prosperity of the State. In brief they are as follows:

WOODLOTS.

1. Produce a valuable crop—fuel wood, poles, posts and timber material.
2. Beautify the landscape and hence make for more comfortable and desirable living conditions.
3. Form wind breaks.
4. Furnish shade for cattle and horses without being damaged, if properly managed.
5. Harbor bird and animal life.
6. Tend to regulate the rate at which surface water is carried off and in this respect they are of great importance on steep slopes.

Any one of these six points is sufficient to warrant the maintenance of a woodlot and in the aggregate they furnish a preponderance of evidence in its favor.

The extent of the farm woodlots in Wisconsin may be realized from the following statistics as given by the U. S. census of 1910:

Total land area in Wisconsin	35,363,840 acres
Improved land	11,907,606 acres
Unimproved land	9,152,460 acres
Woodland in farms	5,317,652 acres

From these figures it can be seen that the woodlots cover an area of almost five and one-third million acres, or about 15 per cent of the total land area of the State. Wooded lands on farms, of course, are distinct from lands that are primarily forested. Thus in Dane county, embracing

769,280 acres, and one of the most highly developed agricultural regions of the State, we find 95,976 acres in woodlots, whereas, in Iron county containing 506,880 acres, most of which is still in the wild state, we find only 4,662 acres in farm woodlots. Their extent depends entirely upon the agricultural development of a region. Using this classification the State may be divided into three main divisions as follows:

1. The southern counties such as Rock, Green, Walworth, Dane or Dodge, in which agriculture is of major importance, and where the wild lands are very limited. In counties of this type, the woodlots are small on the average, but they have a definite place in the management of each farm. An interest is usually taken in their development, and a plan for intensive encouragement is feasible and practical.
2. Counties in the central portion of the state, such as Clark, Waupaca, Chippewa or Langlade, where agricultural development is far advanced, but in which the cut over or forested lands are still of great extent. In these counties the woodlots are just beginning to receive some consideration from farm owners, but very little is done in the way of definite improvements. The woodlot is not as yet recognized as an essential part of the general farm, because of the vast amount of wood material which is still found in all parts of these counties.
3. Counties in the northern part of the state such as Iron, Forest, Vilas, Sawyer or Marinette, which contain a vast acreage of cut over or timbered lands, and in which agricultural development is still in its infancy. In these counties the woodlot is of minor importance at present, although plans for its proper development can be reasonably considered at the present time.

The value of the wood material on the five and one-third million acres of woodlots in Wisconsin would exceed fifty million dollars at the very conservative estimate of ten dollars per acre. Each year hundreds of thousands of cords of firewood and millions of feet of saw logs are hauled from these woodlots, besides great quantities of poles, posts and ties. The value of these products is difficult to approximate, but it is of great importance to the rural communities. But this does not limit the value of the farm woodlot. The birds and small animals are man's best aids in controlling the insect world, and consequently their depredations, on crops, cattle and even mankind, and these are always harbored and encouraged in woodlands. In mitigating the severities of the winds, small stands of timber are of the utmost importance. The woodlot affords those beauties to the landscape of a farming community, the lack of which makes prairie regions so desolate. As a means of preventing severe gullying on steep hillsides or on very light soils, tree growth cannot be excelled. Practically every farm in the state has some land on which a woodlot could be profitably located. In the southwestern portion of the state, where the lands are rough and hilly, the woodlots are best located on the steep slopes, the narrow ridges, or the rock strewn hillsides.

In the central and eastern counties the woodlots should be so located as to give protection from the prevailing winds, or on a lean, stony or eroded portion of the farm. In all parts of the state there are lands unsuited for cultivation, and on such sites quick growing tree species should be planted. It requires very little effort after a woodlot is once started, according to the proper methods, to keep it in good condition. It is always better to have a valuable crop growing slowly on a poor piece of land than to have the site remain completely idle.

The oak woodlots of the southern and particularly the southwestern counties are the best to be found in the State. In many instances the woodlot is located on a piece of land which could be used to better advantage if tilled, or, on the other hand, lean, rocky, or very rough sites are cultivated or pastured, which, if used for tree growth would yield better returns, while the more suitable lands could be cultivated.

The growing stock in the central and northern counties has been so depleted in many instances, that but little reproduction can be expected, and generally the new stand of trees in such circumstances is composed chiefly of inferior species. The condition of the average woodlot is sure to be bad, if the owner cuts his timber with no thought to the future, and is generally indifferent to the advantages gained by the best methods of woodlot development.

EFFECTS OF GRAZING IN THE WOODLOT
REPRODUCTION ENTIRELY LACKING

Consider the possibilities that lie in the way of better woodlot management. The well managed stand of forest trees should produce from three-fourths to one cord of wood material per acre per year. This crop is grown on lands that are unsuited or inferior for tillage or pasture purposes. It is a clear gain from lands that would otherwise remain idle. If we assume that under the present conditions of management, the average woodlot is producing ⅛ of a cord of wood material per acre per year, the 5⅛ million acres yield over 650,000 cords. Figured for fuel purposes, perhaps the lowest economic use to which this material could be put, its value would exceed a half millions dollars. With proper methods of management, this yield could be doubled and even tripled in a few years, and eventually the yield would equal nearly one cord of wood material per acre per year. To Wisconsin, a State possessing no coal and with fuel costs constantly increasing, this product is of especial importance and, if coupled with the other advantages which spring from this source, it undoubtedly warrants better methods of management in the average farm woodlot.

Just what constitutes better silvical systems as applied to woodlot management cannot be discussed here, because of the great diversity of conditions that are met with in the state. Every woodlot has its own problems. The pine stands of the sandy regions of the state require different treatment than the oak woodlots of the southern counties.

With a view towards determining the best systems of management that can be applied in Wisconsin, the woodlots of the following counties, and all factors that might influence their development, have been studied.

Adams
Ashland
Barron
Bayfield
Calumet
Crawford
Columbia
Dane
Dodge
Douglas
Fond du Lac
Green
Jefferson
La Crosse
Langlade
Lincoln
Manitowoc
Marathon
Marinette
Oconto
Ozaukee
Polk
Portage
Richland
Rock
Rusk
Sauk
Shawano
Sheboygan
Taylor
Trempealeau
Vernon
Walworth
Washburn
Washington
Waukesha
Waupaca
Winnebago

It is planned to issue reports from the data compiled during these studies for those regions of the State in which woodlot conditions are of a similar character.

To further encourage woodlot development, the following plan has been adopted by the Conservation Commission.

On request to the commission by the owner of a tract of land, who also agrees to bear the expenses of travel and maintenance of the examiner, a thorough examination of the property is made by an expert forester. The results of this examination are set forth in a practical working plan report. This plan embraces a practical system for the cutting and marketing of small tracts of timber such as farm woodlots, or in case of bare areas or one in need of planting, the report includes a practical planting plan, or where a combination of conditions exists, a combination of both cutting and planting plan is considered. The ideas and desires of the owner of the property examined are always taken into consideration in the preparation of the report. In order to reduce the cost of such examinations to the individual, the requests to the Commission from one part of the State are gathered together, and at a definite time an examiner is sent to complete all examinations in that region. In this way the work is made more systematic for the Commission, and less expensive to the property owner.

In conjunction with this plan of land examination the commission is growing forest trees on a large scale, which will be sold to land owners in the state at the approximate cost of raising them. It is hoped that through the circulation of the instructive pamphlets on woodlot conditions and management, coupled with lectures and personal contact with the owners of woodlots, that a greater interest will be aroused in their favor and that the yield of the woodlots of the state will be materially increased.

APPENDIX

TO

REPORT OF FORESTRY DIVISION.

FOREST FIRE PLAN

FOREST FIRE PLAN

FOR PROTECTION OF HEADWATERS

OF

WISCONSIN AND CHIPPEWA RIVERS

AS DEVELOPED BY THE

WISCONSIN CONSERVATION COMMISSION

IN COÖPERATION WITH THE

FEDERAL GOVERNMENT, CORPORATIONS,
AND INDIVIDUALS

OUTLINE PLAN.

1. ORGANIZATION
    - Protected area
        - Coöperation
    - Diagram protective force
    - Permanent force
        - Head ranger, duties and responsibilities
        - District ranger, duties and responsibilities
        - Forest Assistants
        - Permanent workmen
    - Temporary force
        - Federal patrolmen
        - Workmen
    - Emergency force
        - Local residents
        - Payment of outside fire fighters
2. PREVENTION
    - Cleaning up slashings and fire traps
    - Posting of fire notices and warnings
    - Guidance of tourists
    - Press items and magazine articles
    - Personal appeals
    - Apprehension of individuals who set fires
    - Improvement of spark arresting devices
    - Record of fires
3. DETECTION
    - Lookout towers
        - Equipment
        - Triangulation system for locating fires
        - Instructions to tower men
    - Patrol during dry seasons
        - Instructions to patrol men
    - Hydro-aeroplane observation
    - Communication
        - Telephone lines
            - Inspection
        - Portable phones
4. CONTROL
    - Fire lines
    - Roads and trails
    - Tool boxes
        - Location
        - Equipment
    - Transportation
        - Auto trucks
        - Velocipedes
5. COST OF PROTECTION
6. SUMMARY OF IMPROVEMENTS AND EQUIPMENT
7. DISTRIBUTION OF PROTECTIVE FORCE

ORGANIZATION.

The problem of fire protection is to organize a force of men sufficiently trained and active to prevent the destruction by fire of property within their respective districts. There will always be some fires, the number depending upon the dryness of the season, the number of tourists within the protected area, etc., and therefore the effectiveness of the protective force in fire prevention will vary with the season. Fire protection is necessary from April 1 to December 1, which is considered the fire season. All other activities are subordinate during that period. Careful attention is given to weather conditions, so that during a dry time the various districts can be more carefully patrolled and protected.

Protected area.

The area considered in this plan includes about 74 townships. It is the duty of the protective force not only to protect all tangible property, whether public or private, but also as far as possible, the natural beauty of the region from all destructive agencies.

Within this area the state is aided in protective work during the fire season by:

1. Federal coöperation.
   9 forest fire patrolmen
2. C. & N. W. railroad.
   1 or 2 forest fire patrolmen.
3. C. H. Ferry estate.
   1 forest fire patrolman.
4. Lumber companies within the region.
5. Indian service.

A lookout tower has been erected on the reservation and it is hoped that the officials will enter into active coöperation with the state during the season of 1916.

The patrolmen mentioned above work under the supervision of the Conservation Commission, and receive their pay through the Commission.

The following companies, which own large tracts of land within the fire protective area, are carrying on lumbering operations, and have walking bosses, foremen and other employes going over their timberlands:

Forster-Mueller Lumber Co.,	Hiles, Wis.
Hackley-Phelps-Bonnell Lumber Co.,	Phelps, Wis.
Brooks & Ross Lumber Co.,	Schofield, Wis.
A. H. Stange Lumber Co.,	Merrill, Wis.
Turtle Lake Lumber Co.,	Winchester, Wis.
Vilas County Lumber Co.,	Winegar, Wis.

The state does not assign any patrolmen to service on these lands. However, the patrolmen of the areas adjoining the lands owned by these companies are instructed to watch them for fires and should any occur to take steps to fight them. These companies have authorized the head ranger to call out any of their employes at any time to help in fighting fires, the expense of such work to be borne by the lumber companies.

Diagram of administrative organization:

STATE CONSERVATION COMMISSION.

JAMES NEVIN,
W. E. BARBER,
F. B. MOODY.

Fisheries	Game	Forestry
JAMES NEVIN	W. E. BARBER	F. B. MOODY

Parks	Reforestation	Education	Fire Protection
	(C. L. HARRINGTON)		(E. M. WEAVER)

Permanent force	Temporary force	Emergency force
Rangers (10)	Federal patrolmen (9)	People of the surrounding region:
Forest Assistant (1)	Workmen and laborers	Settlers, Woodsmen
Permanent workman (1)	(5 to 50)	Summer resort owners and employes (300 to 500 men)

Permanent force.

The protective force consists, first, of rangers, forest assistants, patrolmen and laborers employed by the forestry branch of the Conservation Commission within the protected area and, second, of the hired fire fighters and the surrounding population. The latter are of service in the prevention and detection of fires, but are called upon to fight fires only in times of emergency. The protective force is under the direct charge of the head ranger in all matters relating to protection, while each district is supervised by a ranger.

The protected area is subdivided into 17 ranger or patrol districts, varying in size from 60,000 to 138,000 acres. The average number of acres per district is 95,900.

The head ranger is field superintendent of all districts. He is held responsible to the commissioner in charge of forestry activities for the efficiency of the field work in all districts. His duties require him to outline all work that is carried on in each district, especially work to improve the protective system; to make frequent inspections of all work being carried on, of all equipment and of lines of communication; to hire workmen; to look after trespass cases and sales of forest products, and to supervise all other administrative and protective work over the entire area.

In his district the ranger has complete charge of all protective work, and is held responsible to the head ranger for the efficiency of the fire fighting force under him. He must keep posted on general affairs within his district that have any bearing on the fire situation; he must see that the fire fighting apparatus is in shape for service; he must oversee all improvement work such as road building, fire line and trail construction, telephone line maintenance and inspection. He is responsible for the care of all state property within his district.

The forest assistants and permanent workmen are also a part of the permanent protective force. The former have charge of raising the planting material, of the reforestation work on state and private lands and of all work that requires technical training; the latter are employed irregularly throughout the entire year to help with any of the various undertakings. These men are always ready to go on the fire line when occasion demands. They are for the most part trained fire fighters and are generally well acquainted with the region.

Temporary force.

Under the Weeks law the National government coöperates with the state in forest fire protection on the headwaters of the Wisconsin and Chippewa rivers. In 1915 a fund of $4,500 was obtained from which 8 patrolmen were kept in service during the fire season (April 1 to December 1). They, with the general laborers, constitute the temporary fire fighting force. They are all men experienced in fighting fires, and during dry seasons are either on lookout or patrol duty. During times of little danger, as after heavy rains, they help in the maintenance and construction of roads, trails and telephone lines. At the beginning of the fire season each federal patrolmen is assigned a definite area to patrol. His route is outlined, and he is expected to comply with all provisions in the set of instructions furnished him.

Emergency force.

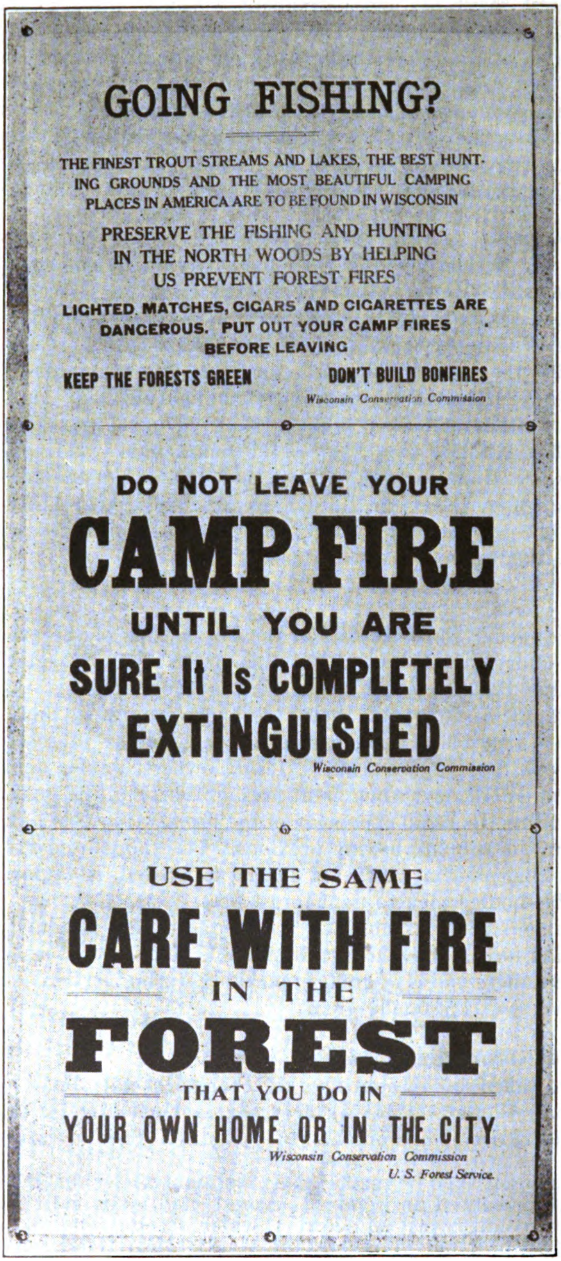
The emergency force consists of the inhabitants of the protected area. Under ordinary circumstances these men act as a detection and prevention force in that they report fires that occur without making any attempt to put them out, and through their care and warnings to those inclined to be shiftless with camp fires, brush fires, etc., many fires are prevented. These people are largely settlers, resort owners, guides and woodsmen. In times of emergency, when great fires are burning, the presence of these people permits the rapid expansion of the fire fighting force, as each ranger and federal patrolman, having previously been appointed fire warden by the town chairman in which his district is located, is empowered to call out all able-bodied men to fight forest fires.

The rangers have a thorough knowledge of the available emergency fire fighting force. The emergency force is composed of several hundred able-bodied men, and is of great importance during very dry seasons when the fire risk is exceptionally great.

Payment of outside fire fighters.

All men called out to fight fires by a ranger or patrolman who is acting under his authority as fire warden, are paid one-half by the county in which the fire occurs and one-half by the state. The law further provides:

> "No payment shall be made to any claimant under this section until he shall have presented an itemized account, and made oath or affirmation that said account is just and correct, which account shall be approved by the county board, and audited by the county clerk. The county clerk shall thereupon issue to such claimant his warrant upon the county treasurer for the sum to which such claimant is entitled and the county treasurer shall pay the same.



GOING FISHING?

THE FINEST TROUT STREAMS AND LAKES, THE BEST HUNTING GROUNDS AND THE MOST BEAUTIFUL CAMPING PLACES IN AMERICA ARE TO BE FOUND IN WISCONSIN

PRESERVE THE FISHING AND HUNTING IN THE NORTH WOODS BY HELPING US PREVENT FOREST FIRES

LIGHTED MATCHES, CIGARS AND CIGARETTES ARE DANGEROUS. PUT OUT YOUR CAMP FIRES BEFORE LEAVING

KEEP THE FORESTS GREEN DON'T BUILD BONFIRES

Wisconsin Conservation Commission

DO NOT LEAVE YOUR
CAMP FIRE
UNTIL YOU ARE
SURE It Is COMPLETELY
EXTINGUISHED

Wisconsin Conservation Commission

USE THE SAME
CARE WITH FIRE
IN THE
FOREST
THAT YOU DO IN
YOUR OWN HOME OR IN THE CITY

Wisconsin Conservation Commission
U. S. Forest Service.

FOREST FIRE PREVENTION PLACARDS DISTRIBUTED BY THE CONSERVATION COMMISSION

"The county clerk shall transmit the original oath and copy of the warrant to the secretary of state, who shall audit such claim, and one-half thereof shall be paid out of the general fund of the state treasury by warrant issued by the secretary of state upon the state treasurer in favor of the county which paid such claimant. However, no county shall expend more than five thousand dollars under this act in any one year."

At the last session of the legislature further provision was made for two years of "a sum sufficient for the protection from forest fires of any lands owned by the state north of town 33." Under this law specific amounts can be obtained from the state treasury for payment of fire fighters upon a written order of the Governor. This law applies to the protection of state lands only.

PREVENTION.

Prevention of fires is essential in a protective system. If the causes of fires can be eliminated, or partially eliminated, and there is every reason to believe they can be, the risks and the cost of protection will decrease accordingly. For the prevention of forest fires the following measures have been adopted on the protected area:

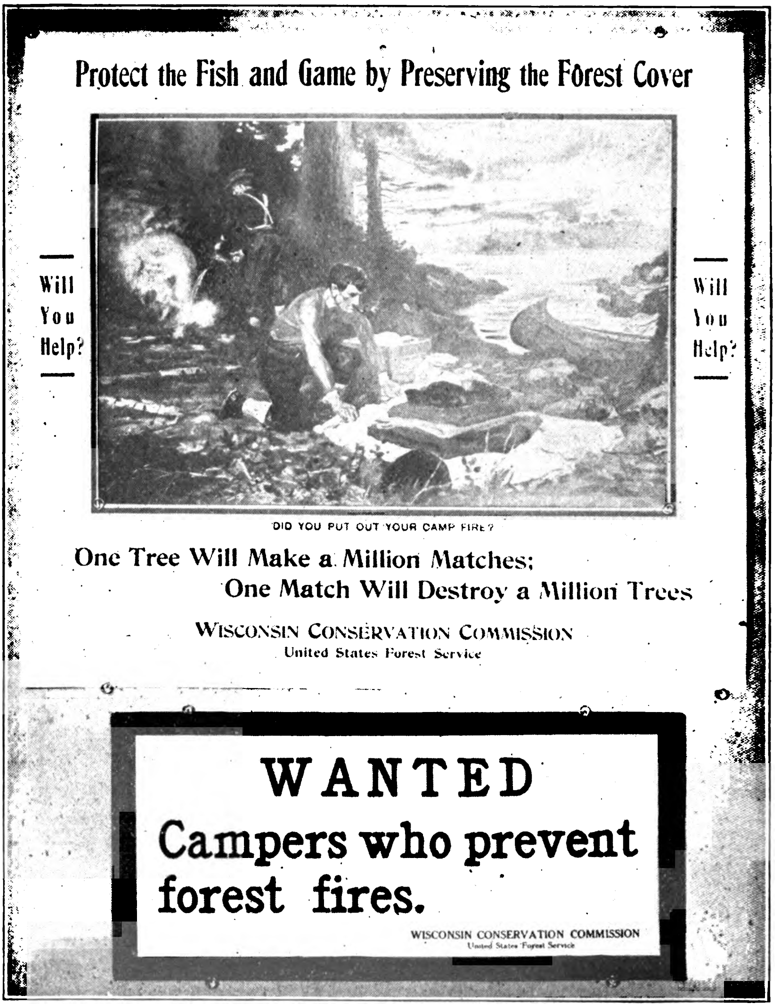
1. Cleaning up slashings and fire traps.
2. Posting of fire notices and warnings.
3. Directing of tourists.
4. Printed and personal appeals.
5. Apprehension of persons setting fires.
6. Improvement of spark arresting devices.
7. Record of fires.

Cleaning up slashings and fire traps.

Each ranger and patrolman is expected, during his regular work, to locate and map all slash areas within his district, and at a favorable time, usually in the fall when the frost covers the ground in the morning, to systematically burn these fire traps. The fiercest and most destructive fires are caused by the uncontrolled burning of old slashings, and as long as such areas exist, there will be great danger of fires. The burning of these slashings during a time when fires will not run, and the systematic control of the work greatly reduces the danger. In this manner hundreds of acres of old slash have been cleaned up on the protected area.

Posting of fire notices and warnings.

For the guidance and instruction of all persons within the protected area regarding forest fires, signs and posters are placed at conspicuous places, such as trails, crossroads, railroad stations, camping sites, school houses and summer resorts. These signs are informal and appeal to the reader to aid in preventing fires, or to extinguish them in all cases, because of the destruction or endangering of property or natural resources. Each spring signs of this type are posted, bearing new designs and instructions, in order that the fire danger for that year may be refreshed in the minds of the people of the protected region. These signs and posters are very effective in calling attention to the fire danger, and in constructive education of all who visit the lake region regarding the real status of forest fires.



Protect the Fish and Game by Preserving the Forest Cover

Will You Help?

Will You Help?

DID YOU PUT OUT YOUR CAMP FIRE?

One Tree Will Make a Million Matches;
One Match Will Destroy a Million Trees

Wisconsin Conservation Commission
United States Forest Service

WANTED

Campers who prevent forest fires.

WISCONSIN CONSERVATION COMMISSION
United States Forest Service

FOREST FIRE PREVENTION PLACARDS DISTRIBUTED BY THE CONSERVATION COMMISSION

During times of extreme drought special red fire warnings are issued and posted by the town chairmen, prohibiting the setting of all fires except those necessary for warming the person or preparing food. This is a special preventive measure and is resorted to only in times of great danger.

Directing of tourists.

Throughout the protected area many ideal camping sites have been laid out by resort owners, forest rangers, or campers. In most cases these camp sites are equipped with stone fireplaces, tables and benches. The protective force, each season, endeavors to guide all camping parties to such locations, as the starting of fires in definite spots which have been previously arranged for such use, always decreases the danger of such a fire developing into a forest fire. On such camp grounds the combustible material about the fireplace is cleaned up, and the site put in good condition for campers.

Press items, magazine articles.

From time to time articles regarding protective work are issued for the instruction of the people at large. This is a direct effort to train the public to be careful with fires. It results in a decrease of forest fires, and brings home to the public one phase of the conduct expected of them when visiting the great resort region of the state. These articles arouse interest, not only in forest fire protection, but also in other forest activities.

Personal appeals.

The forest ranger or patrolman, whenever occasion permits, is expected to call upon settlers, campers, resort owners, woodsmen and all others within his district to warn them of any particular fire danger, or to instruct them in being more cautious in setting fires. Under ordinary circumstances many fires are prevented in this manner especially on the part of new campers who unintentionally leave their camp fires burning. The rangers or patrolmen often visit camping parties in the more out of the way places and call their attention to the danger of leaving fires in exposed or dangerous places, or, at other times, advise a settler regarding the best time and method of burning brush. This method of prevention can be made very efficient if the rangers and patrolmen are men of tact and good personality, and as a general rule men of these qualities make up the force.

Apprehension of persons setting fires.

Occasionally some malicious person sets a forest fire. In such cases the ranger or patrolman who has charge of the district in which the suspected incendiarism has occurred takes steps to apprehend the offender. A thorough investigation is made and if the evidence collected is deemed sufficient to convict the offender, criminal action is brought against him.

Improvement of spark arresting devices.

One of the most serious causes of forest fires has been the live sparks thrown from locomotives. Of late years the attitude of the large, as well as the small railroad companies, has been radically changed in regard to their responsibility in this respect, and as a result we find that today the companies are very thorough in their inspection of ash pans and front end netting. This change of attitude has been brought about largely by an inspector, which the commission was authorized by law to employ. The law now provides that all locomotives on main lines must be equipped with efficient spark arresters, and that locomotives on branch lines or spurs in the protected region must have screens over the smoke stacks, so as to prevent the escape of sparks. These measures have resulted in a very material reduction in the number of fires which annually were attributed to this cause.

Record of fires.

Each ranger is required to keep a record of all fires which occur within his district. The date of each fire, location, area burned over, when and by whom reported, and all other points of information bearing upon the fire are recorded.

DETECTION.

Lookout towers.

Four main and four auxiliary lookout towers are maintained within the protective area as follows:

	Height	Approximate Area of View.
1. Muscalunge Lake Tower	55 ft.	100 sq. mi.
2. Tomahawk	55 ft.	144 sq. mi.
3. Rest Lake Tower	55 ft.	64 sq. mi.
4. Oxley Lake Tower	55 ft.	64 sq. mi.

Auxiliary towers	Height	Approximate Area of view
1. Camp No. 2 Lookout	40	36 sq. mi.
2. Tower in 41–3	20	36 sq. mi.
3. Tower in 40–3	20	36 sq. mi.
4. Tower in 40–14	20	36 sq. mi.

The five towers first named are of steel construction, each 55 feet high and each set upon prominent hills so that they command a complete view of the surrounding country; the auxiliary towers are tall poles also set on prominent hills. Into each auxiliary tower iron steps have been screwed, which permits of easy climbing, and thus a patrolman can obtain a good view of the surrounding country. These towers are of primary importance in the detection of forest fires.

Each tower is equipped with:

1. A mounted and oriented field map, with protractor.
2. One alidade.
3. One pair of field glasses.
4. One wall telephone instrument.
5. One portable telephone.
6. One shovel and canvas pail.
7. One set of telephone repair tools.

The field glasses enable the observer to obtain a clearer view of the surrounding country. Should a fire be discovered, the observer immediately notifies both headquarters and the nearest ranger, giving the bearing of the fire from the tower, and its general appearance. Although the lookout observer is distinctly a detector of fires, there are times when a fire may occur close to the tower, and it is then his duty to go to the fire and commence an attack, and stay until relieved by the ranger or patrolman who comes to fight the fire with the necessary help.

As a general rule a fire is visible from more than one tower, and thus two bearings are reported to headquarters. From these two angles the exact location of the fire can be determined. This is known as the triangulation method of location.

Each tower is located on a map at headquarters which corresponds with the fire map on each tower, and strings are used to mark off the bearings, as reported by the towerman, on a circle graduated to degrees. The intersection of these strings gives the location of the fire, thus enabling the ranger or patrolman, with his knowledge of the roads and trails, to get to the fire in the shortest possible time.

The following instructions apply to each tower man:

> "Continuous observation between the hours 7:00 a. m. and 6:00 p. m. is absolutely necessary during such weather as requires lookout duty, and all watchmen are required to be at their stations between the above mentioned hours.
>
> "As soon as a fire is located call headquarters and get in communication with the ranger nearest the fire. If the fire is outside the district of any ranger, then call any person having a telephone within the fire zone and request him to get to the fire as soon as possible, and to notify the nearest fire warden or ranger.
>
> "Every effort should be made to obtain the coöperation of settlers, resort owners, and other persons who can be helpful in the territory covered by the lookout.
>
> "Each morning before leaving the ranger station call headquarters camp to see if the line is in good order, and after getting to the tower call headquarters to be sure the line is in good working order, and if the line is out of order repair it immediately.
>
> "You should submit a report on the weekly report blanks to E. M. Weaver, head ranger, Woodruff, Wis. When weather conditions are such that it becomes unnecessary to be on the lookout for fires, you will receive instructions from head ranger Weaver, regarding your further duties."

For the detection of forest fires the lookout tower is very efficient except during cloudy or hazy weather. At such times the area over which a clear view can be obtained is reduced. Even under such circumstances the value of the tower is very great.

Patrol during dry seasons.

During dry seasons the patrolmen are actively engaged in patrolling the area assigned to them by the head ranger at the beginning of the fire season, and according to the instructions with which they are provided. They cover the territory in which the greatest fire danger exists, such as along railroads and near the more popular lakes. Each man is equipped with a shovel, a canvas pail and oftentimes with a portable phone. In the protected area the shovel is the best tool for fighting fires as the soils are light and easily handled. The patrolmen operating along the railroad tracks travel on hand pedes, a permit to operate over the tracks being held by each member of the regular force. The track patrolmen are generally equipped with a shovel and collapsible canvas pail. As often as possible the patrolmen get in touch with the lookout towers, by phone, during the day. The general method of track patrol is to follow all trains entering the protected area until they have passed through, and extinguish all fires that might be set as soon as possible.

Hydro-aeroplane observation.

During the summer of 1915 the owner of a hydro-aeroplane stationed at Trout Lake offered his services for fire detecting purposes. His offer was accepted, and the experiment proved of no little value. The range of view from this machine took in from 15 to 40 miles radius with the naked eye, and over 60 miles when strengthened with a pair of field glasses. Over this vast area fires could be readily detected. The hydro-aeroplane would be a successful means for detecting fires were it not for the fact that flights are as yet very hazardous when a strong wind is blowing and it is during just such periods that fires break out and make their greatest headway. However, it is believed that eventually the aeroplane will be a practical device for patrolling great areas of land as the speed of one of these machines is such that three or four counties could be readily patrolled each day.

Communication.

The most important points within the protective area, such as ranger stations, lookout towers, and the small towns are all connected by telephone lines, some of which are owned by the state, others are the general toll systems. The state has over 80 miles of telephone lines in active service. All of the state lines radiate from headquarters, at which point a switchboard is located which enables connections to be made between the different state lines or with the general toll system. They insure rapid communication regarding the location and condition of any fire that may occur. Every effort is made to keep these lines of communication open and in good condition, this service ranking next to actual fire fighting. In order to do this each ranger is required to call headquarters every morning to test out his line.

Portable phones are a part of the equipment of most of the districts. These phones are convenient for communicating while patrolling along telephone lines, and often save the patrolman many miles of walking or riding to report a fire. The value of these instruments lies in the saving of time in reporting a fire and summoning help. Portable phones are located as follows:

Headquarters	2	Woodruff	1
Oxley	1	Manitowish	1
Star Lake	1	Sayner	1
Plum Lake	1		

CONTROL.

This subject takes up all points involved in the fighting of a fire after it has started. The control system includes all fire lines, roads, trails, fire fighting equipment, tool boxes and other devices of the protective system which aids in bringing a fire under control in the shortest time.

Fire lines.

Fire lines are narrow open lanes (10 to 50 feet wide) from which all inflammable material has been cleared. They are usually plowed. The main object of a fire lane is to provide a cleared place from which to attack a forest fire. Fire lanes divide the country up into small units and thus prevent disastrous fires by limiting each fire to a small area. The protective area has been netted with fire lanes.

Natural barriers are used wherever possible. Thus the lanes frequently connect lakes or rivers; run along ridges or skirt areas of great fire danger or special importance such as plantations. Old railroad grades are often made to serve as barriers or secondary roads by pulling up the ties and plowing. The fire lane is not supposed to serve as a point at which every individual fire will stop without action on the part of the protective force, although this often happens. They furnish a cleared space at which a fire can be checked either by a back fire or direct fighting with sand or water.

Roads and trails.

Roads and trails are absolutely necessary in the managing of any forest, particularly in a fire protection plan. All parts of the country must be accessible in order to permit rapid transporting of fire fighting crews, or to facilitate patrol work.

In order to make the area accessible to the force, to the few settlers who live in this region and to the thousands of tourists who annually visit it, over 250 miles of dirt roads have been constructed. Some of these are first class turnpikes, while others are old logging railroad grades, which were improved. The latter are always serviceable for teams or automobiles. In every case the roads are a part of the fire line system.

Many lakes within the protected area are connected by portage trails which are often of great advantage in getting to a forest fire. Besides these, many miles of trails have been opened up in all parts of the area which aid to the accessibility of the region.

Tool boxes.

Boxes containing fire fighting tools are located at strategic points throughout the area for the use of fire fighting crews. The keys to these tool boxes are left with some responsible person, usually the station agent, who is instructed to give the keys to anyone who needs the tools for fire fighting purposes. These tool boxes are an important part in the fire fighting system as they obviate the need of transporting tools for long distances, and at times furnish a source of tools to an emergency fire fighting force. Tool boxes are located at:

Mercer, Powell, Arbor Vitae, Star Lake, Boulder Junction, Tomahawk Lake, Robbins, Conover, Gagen and Sayner.

The standard equipment of a tool box consists of:

12 shovels; 12 galvanized pails; 6 grub hoes; 6 axes; 6 mattocks, and 6 rakes.

These tools are kept in good repair and are sufficient to equip a fire fighting crew of from 12 to 18 men.

Cutting stubs.

Old dead stubs are dangerous when standing along roadsides or fire lines, since sparks from such a height are carried for long distances. Such old stubs have been cut back for from 6 to 10 rods on each side of over 125 miles of roads and fire lanes. Such work as this is generally carried on during the winter months and is an important step in the control of fires.

Transportation.

Rapid transportation of a fire fighting crew is essential to efficient control of forest fires. In order to accomplish this, an auto truck is stationed at headquarters camp which is held in readiness, especially during times of drought. This truck will accommodate from 6 to 10 men with their equipment. Coupled with a good system of roads and trails, the truck is invaluable in getting to a fire in the shortest possible time. Instances have occurred when a reported fire was reached in from 20 to 30 minutes with the truck, whereas with a team or by foot the time required would be between one and two hours. The advantage gained is readily realized. Not only is the fire fighting crew in good physical trim after reaching the fire and therefore able to do better work, but the fire has had but little time to gain headway, and is, therefore, extinguished with comparative ease. The truck is also very serviceable in reforestation work for the transportation of plant stock, equipment and men, and in general administration.

The C. M. & St. P. Ry., C. & N. W. Ry., and the "Soo" line, in coöperation with the Conservation Commission have granted permits to all rangers, patrolmen and forest assistants, to operate velocipedes over their lines within the protected area. This is a direct advantage in patrol work along railroads, because of the special fire hazard, and also in getting to fires which occur along the rights of way in the shortest time. This privilege aids greatly in the work of detecting and controlling forest fires.

COST OF PROTECTION.

The following figures give the cost for fire protection during 1915:

The state expenditures in 1915 were	$11,039 .13
Private expenditures under state supervision were	765 .00
Government expenditures	4,498 .20
Total expenditures under state supervision	$16,302 .33

Acreage in fire protected area	1,250,000
Cost per acre for protection	$ .013

The area for 1916 has been increased to about 1,700,000 acres, inclusive of the Indian Reservation.

SUMMARY OF IMPROVEMENTS, EQUIPMENTS AND DISPOSITION OF THE FOREST PROTECTIVE PERSONNEL.

IMPROVEMENTS

Stations:	Location
Headquarters Camp	Sec. 8, T. 41–7 E.
Plum Lake Ranger Station	Sec. 29, T. 41–8 E.
Star Lake Ranger Station	Sec. 15, T. 41–8 E.
Tomahawk Lake Ranger Station	Sec. 4, T. 38–7 E.
Carroll Lake Ranger Station	Sec. 4, T. 39–7 E.
Wildcat Lake Ranger Station	Sec. 34, T. 43–7 E.
Oxley Ranger Station	Sec. 24, T. 42–6 E.
Rest Lake Ranger Station	Sec. 4, T. 42–5 E.
Patrol Cabin	Sec. 28, T. 41–7 E.
Patrol Cabin	Sec. 12, T. 42–8 E.
Patrol Cabin	Sec. 14, T. 43–7 E.
Patrol Cabin	Sec. 32, T. 42–4 E.

Lookout Towers.

Primary Lookouts	Location
Muskellunge Lookout Tower	Sec. 34, T. 41–7 E.
Oxley Lookout Tower	Sec. 23, T. 42–6 E.
Tomahawk Lookout Tower	Sec. 27, T. 39–7 E.
Rest Lake Lookout Tower	Sec. 4, T. 42–5 E.
Flambeau Lookout Tower	Sec. 34, T. 41–5 E.

Auxiliary Lookouts	
Camp No. 2 Lookout	T. 42–8 E.
Lookout	T. 41–3 E.
Lookout	T. 40–3 E.
Lookout	T. 40–14 E.

Roads.

About 250 miles of dirt roads constructed at an average cost of $131.58 per mile.

Fire lanes.

About 141 miles constructed at an average cost of $84.67 per mile.

Telephone lines.

Over 80 miles constructed at an average cost of $35.93 per mile.

Slash burning.

Slash burned on over 1500 acres at an average cost of about $5 per acre.

EQUIPMENT.

One auto truck located at headquarters.
10 fire tool boxes. (Standard equipment)

Location

- Mercer
- Powell
- Arbor Vitae
- Star Lake
- Boulder Jct.
- Tomahawk Lake
- Robbins
- Conover
- Gagen
- Sayner

Eight portable phones

Location

Headquarters	2
Oxley	1
Star Lake	1
Plum Lake	1
Woodruff	1
Manitowish	1
Sayner	1

Four lookout kits each consisting of:

- A mounted and oriented field map.
- One alidade.
- One pair of field glasses.
- One wall telephone instrument.
- One portable telephone.
- One shovel and canvas pail.
- One set of telephone repair tools.

Ten Velocipedes located as follows:

Headquarters 4, Woodruff 1, (Gas car); Oxley 1, Sayner 1, Star Lake 1, North Crandon 1, Wildcat Lake 1.

Each station is also equipped with shovels, pails, rakes, mattocks and all other necessary fire fighting tools, besides camping kits, telephone repair tools, tents, maps and all other paraphernalia needed for the protective system.

COMMISSIONERS OF FISHERIES.

FINANCIAL REPORT.

July 1, 1914 to June 30, 1915

OPERATION ACCOUNT.

July 1, 1914.	Annual Appropriation	$48,500.00	
June 28, 1915.	Refund H. C. Prange Co	23.00	
June 30, 1915.	Total disbursements		$46,189.54
July 1, 1915.	Balance on hand		2,333.46
		$48,523.00	$48,523.00

REPAIRS & MAINTENANCE.

July 1, 1914.	Appropriation	$3,250.00	
	Total disbursements		$3,210.00
July 1, 1915.	Balance on hand		40.00
		$3,250.00	$3,250.0

LAND AND IMPROVEMENTS,

July 1, 1914.	Appropriation	$4,910.00	
	Total disbursements		$4,885.00
July 1, 1915.	Balance on hand		25.00
		$4,910.00	$4,910.00

MISSISSIPPI RIVER FUND. (SEC. 172–22–4)

Total amount collected to June 30, 1915	$9,485.36
Disbursements	2,434.27
Amount on hand July 1, 1915	$7,051.09

ADMINISTRATION AND OFFICE EXPENSE.

Salaries	$5,410.08	
Traveling expenses	433.39	
Printing, postage, telephone, office supplies	906.78	
		$6,750.25

Madison Hatchery.

Salaries	$3,440.00	
Sundry labor	267.75	
Supplies and equipment	1,085.89	
Fish food	969.09	
Repairs and improvements	2,161.03	
		$7,923.76

Bayfield Hatchery.

Salaries	$3,322.00	
Sundry labor	645.35	
Supplies and equipment	923.18	
Fish food	886.38	
Repairs and improvements	1,225.57	
		$7,002.48

Oshkosh Hatchery.

Salaries and labor	$371.50	
Supplies and equipment	200.81	
		$572.31

Minocqua Hatchery.

Salaries and labor	$1,242.00	
Supplies and equipment	920.41	
		$2,162.41

Delafield Hatchery.

Salaries and labor	$1,873.48	
Supplies and equipment	187.49	
		$2,060.97

Wild Rose Hatchery.

Salaries	$2,670.00	
Sundry labor	585.71	
Supplies and equipment	546.38	
Fish food	796.17	
Repairs and improvements	1,058.70	
		$5,656.96

Sturgeon Bay Hatchery.

Salaries	$1,080.00	
Sundry employment	1,071.05	
Supplies and equipment	1,305.12	
		$3,456.17

Sheboygan Hatchery.

Salaries	$1,166.34	
Sundry employment	1,207.00	
Supplies and equipment	1,195.55	
		$3,568.89

Spooner Hatchery.

Labor, equipment and supplies	$405.38	
		$405.38

Eagle River Hatchery.

Completing building	$666.78	
Labor, supplies and equipment	660.01	
		$1,326.79

Transportation and Distribution.

Salaries and labor	$705.25	
Freight, dray and express	2,270.58	
Employee's traveling expenses	4,565.96	
Supplies and equipment	468.07	
		$8,009.86

Miscellaneous.

Collecting lake trout, bluefin and pike eggs	$3,474.85	
State Fair Exhibit	131.50	
State Insurance	527.52	
Overdraft from fiscal year ending June 30, 1914	1,254.44	
		$5,388.31
Grand Total		$54,284.54

Total appropriation	$56,660.00	
Refunded by H. C. Prange Co	23.00	
Total disbursements		$54,284.54
Unexpended balance		2,398.46
	$56,683.00	$56,683.00

FINANCIAL STATEMENT FOR YEAR ENDING JUNE 30, 1915

(Old Boards and Commissions)

Forestry Board	$ 40,629.94
Park Board	22,733.67*
Fish Commission	53,030.10
State Game Warden	135,813.37
Total	$252,207.08

(*) Covers Marquette, Peninsular, Devil's Lake and Interstate parks.

FINANCIAL STATEMENT FOR YEAR ENDING JUNE 30, 1916

(New Conservation Commission)

Forestry Division	$ 25,286.19
State Park Division	17,681.65†
Fisheries Division	52,598.67
Warden Division	110,783.22
Total	$206,349.73*

(*) The office or administration expense was prorated among the four divisions.
(†) Covers Marquette, Peninsular, Devil's Lake, Interstate and Cushing Memorial parks.

CLASSIFIED FINANCIAL STATEMENT.

July 1 1915, to June 30, 1916

GENERAL ADMINISTRATION.

Salaries, commissioners and office force	$ 17,666.20
Traveling expenses	2,550.47
Office supplies	761.31
Printing	5,139.23
Postage	1,528.65
Telegraph and telephone	369.65
Freight, dray and express	182.62
Total	$ 28,202.13

FORESTRY DIVISION.

Salaries and sundry labor	$ 7,083.55
Supplies	1,147.60
Employee's expenses	1,399.44
Equipment	199.01
State Insurance	170.99
July, 1915, disbursements under old department	3,689.99
Total	$ 13,690.58

FORESTRY DIVISION (FIRE PROTECTION).

Sundry labor	$ 2,935.84
Supplies	1,039.89
Equipment	150.00
Employee's expenses	419.88
Total	$ 4,545.61

STATE PARKS DIVISION.

Peninsular Park, (Salaries, labor, supplies)	$ 3,824.24
Devil's Lake Park, (Salaries, labor, supplies)	4,028.44
Interstate Park, (Salaries, labor, supplies)	1,776.65
Marquette Park, (Salaries, labor, supplies)	196.98
Brule Park, (Salaries, labor, supplies)	342.88
Cushing Park	295.00
State Insurance	167.46
Total	$ 10,631.65

WARDEN DIVISION.

Salaries	$ 57,762.41
Warden's Expenses (Railroad fare)	4,704.36
Warden's Expenses (Hotel expense)	16,420.82
Warden's Expenses (Livery)	5,008.80
Warden's Expenses (Telephone, telegraph, supplies)	2,378.06
Supplies and repairs	2,432.72
Equipment	2,992.34
State Game Farm	131.24
State Insurance	78.55
July, 1915, disbursements under old department	11,821.79
Total	$103,731.09

FISHERIES DIVISION

Madison Hatchery.

Salaries and sundry labor	$3,147.85	
Fish food	746.76	
Equipment	154.00	
Supplies and repairs	487.62	
		$4,536.23

Bayfield Hatchery.

Salaries and sundry labor	$3,945.45	
Fish food	696.35	
Equipment	221.77	
Supplies and repairs	818.90	
Improvements	1,302.28	
		$6,984.75

Oshkosh Hatchery.

Sundry employment	$ 160.00	
Equipment	110.00	
Supplies and repairs	138.51	
Improvements	2,543.21	
		$2,951.72

Minoqua Hatchery.

Salaries and sundry labor	$1,243.75	
Equipment	80.00	
Supplies and repairs	579.19	
Improvements	242.42	
		$2,145.36

Delafield Hatchery.

Salaries and sundry labor	$2,099.70	
Supplies and repairs	102.56	
		$2,202.26

Wild Rose Hatchery.

Salaries and sundry labor	$2,839.54	
Fish food	819.49	
Equipment	152.04	
Supplies and repairs	321.55	
Improvements	508.39	
		$4,641.01

Sheboygan Hatchery.

Salaries and sundry labor	$2,249.50	
Water rent	606.48	
Supplies and repairs	558.08	
		$3,414.06

Sturgeon Bay Hatchery.

Salaries and sundry labor	$1,643.00	
Water rent	504.13	
Supplies and repairs	286.19	
Improvements	308.34	
		$2,741.66

Sub-Hatcheries.

Spooner, (Labor and supplies)	$297.70	
Eagle River, (Labor and supplies)	126.11	
Madison, (Erecting and equipping)	730.19	
		$1,154.00

Distribution of Fish.

Salaries and sundry employment	$791.00	
Employees' expenses	3,806.88	
Freight, dray, express	1,631.04	
Supplies	450.31	
		$6,679.23

Miscellaneous Disbursements.

Collecting fish at Neenah Dam	$500.17	
Collecting lake trout eggs	804.81	
Collecting pike eggs	2,281.47	
State Insurance	529.32	
July, 1915, disbursements under old Dept	3,982.62	
		$8,098.39
Grand Total Fisheries Division		$ 45,548.67
Grand Total, all Departments		$206,349.73

Recapitulation.

Salaries	$109,907.59
Per diem	17,069.27
Fish Food	2,680.72
Equipment	4,467.15
Supplies	11,304.26
Printing	5,139.23
Postage	1,529.65
Telephone and telegraph	722.88
Employees' traveling expenses	41,805.47
Dray, freight, express	1,872.04
State Insurance	867.77
Property and Improvements	3,996.40
Repairs and Maintenance	4,987.30
Grand Total	$206,349.73

General operation	$197,366.03
Repairs and Maintenance	4,987.30
Property and Improvements	3,996.40
Grand Total	$206,349.73

Appropriation for Operation (172–42–1)	$200,000.00	
Repairs and Maintenance (172–42–2)	5,000.00	
Property and Improvements (172–42–3)	4,000.00	
Total disbursements		$206,349.73
Unexpended balance on hand July 1, 1916		2,650.27
	$209,000.00	$209,000.00

Administration and Office expenses	$ 28,202.13
Warden Division	103,731.09
Forestry Division	13,690.58
Forestry Division (Forest Fire Protection)	4,545.61
State Parks Division	10,631.65
Fisheries Division	45,548.67
Total	$206,349.73

Statement of Salaried Employees.

Commissioners and office force	9
Conservation warden force	63
Parks Division	4
Fisheries Division	17
Forestry Division	10
	103
Short period employees in the parks, forestry and fisheries divisions, hired as extra help when necessary	230
Regular and extra men employed during fiscal year	333

FOREST RESERVE FUND.

Balance July 1, 1915	$11,040.45	
Receipts	13,144.94	
Expenditures		$ 79.70
Balance, July 1, 1916		24,105.69
	$24,185.39	$24,185.39

GOVERNMENT REFORESTATION FUND.

Balance July 1, 1915	$12,694.82	
Receipts	737.47	
Expenditures		$ 3,685.21
Balance, July 1, 1916		9,747.08
	$13,432.29	$13,432.29

PARK PURCHASE FUND.

Balance, July 1, 1915	$10,825.34	
Receipts for year	1,870.12	
Balance available		$12,695.46
	$12,695.46	$12,695.46

GLENN PARK FUND.

Balance on hand	$5,999.84
Disbursements	1,181.74
Balance on hand July 1, 1916	$ 4,818.10

DEVIL'S LAKE PARK FUND.

Balance on hand	$ 45.66
Disbursements	38.70
Balance on hand July 1, 1916	$ 6.96

PENINSULAR PARK FUND.

Balance on hand	$ 231.01
Disbursements	231.01

FOREST FIRE PROTECTION.

(Coöperative Disbursements)

Paid by U. S. Government under Weeks Law	$3,813.00
Paid by Mansfield Ferry, New York City	$ 370.00

WISCONSIN CONSERVATION COMMISSION CLASSIFICATION OF RECEIPTS.

July 1, 1915, to June 30, 1916

Nonresident Anglers' Licenses	$23,215.83
Lake Michigan, Superior & Green Bay licenses	4,208.00
Lake Pepin, St. Croix & Mississippi River Licenses	2,811.75
Rough Fish (Winnebago County waters)	2,578.36
Rough Fish (other waters)	9,632.11
Resident Hunting licenses	133,578.50
Nonresident Hunting licenses	11,670.00
Duplicate licenses	106.50
Settlers' licenses	632.00
Confiscations	2,730.48
Wardens' fees	554.75
Fines imposed (credited to School Fund)	16,969.50
Set Line licenses	1,728.70
Game Farmers' licenses and registration fees	1,092.39
Concessions from park lands	1,870.12
Island leases and nursery stock sales	737.47
Ground leases, timber sales, trespass, etc	13,144.94
Total	$227,261.40

INVENTORY.

FISHERIES DIVISION.

Madison Hatchery	
63 acres of land, 7 buildings, 17 ponds, 1350 feet of raceway	$35,000.00
Tools and equipment	4,000.00
Bayfield Hatchery	
502 acres of land, 6 buildings, 26 ponds, 1500 feet of raceway, 6700 feet of pipe line	45,000.00
Tools and equipment	5,000.00
Oshkosh Hatchery	
One city lot, hatchery building, boathouse and dock	7,000.00
Tools and equipment	2,500.00
Minocqua Hatchery	
275½ acres of land, 5 buildings, 7 ponds, 2200 feet of pipe line	25,000.00
Tools and equipment	2,500.00
Delafield Hatchery	
30 acres of land, hatchery building, 6 ponds, 1490 feet of pipe line	27,000.00
Tools and equipment	1,500.00

Wild Rose Hatchery	
59½ acres of land, 5 buildings, 32 ponds, 1035 feet of pipe line	$25,000.00
Tools and equipment	1,500.00
Sturgeon Bay Hatchery	
2 city lots, hatchery building	10,000.00
Tools and equipment	1,000.00
Sheboygan Hatchery	
City lot and hatchery building	10,000.00
Tools and equipment	1,000.00
Spooner Hatchery	
City lot and building	1,500.00
Tools and equipment	700.00
Eagle River Hatchery	
City lot and building	1,500.00
Tools and equipment	700.00
Tenney Park Hatchery	
Building	500.00
State Fish Car "Badger No. 2"	13,500.00
Car shed at Wild Rose	1,500.00
Total	$222,900.00

INVENTORY.

Warden Division	
25 motorcycles	$5,000.00
Launch "Beda"	1,000.00
Launch "Anna S"	750.00
Launch "Kingfisher"	1,000.00
Launch "Wisconsin"	100.00
Launch "Submarine"	150.00
Launch "Galatea"	1,500.00
12 detachable boat motors	780.00
14 row boats	350.00
Automobile	1,500.00
3 Ford trucks	1,000.00
Total	$13,130.00

State Parks Division		
Devil's Lake park—	Buildings	$20,350.00
	1040 acres of land	128,497.00
Peninsula Park	Buildings and two lookout towers	17,255.00
	3190 acres of land	96,182.00
Marquette Park	Buildings	1,160.00
	1651 acres of land	46,139.00
Interstate Park	Buildings	400.00
	580 acres of land	20,571.00
Cushing Memorial Park	8 acres of land	5,000.00
Actual cost to state		$335,554.00

Forestry Division

37 buildings	$28,690.00
4 steel lookout towers	550.00
86 miles telephone line	3,150.00
Trout Lake Nursery (land improvements, water system, equipment)	4,700.00
Tomahawk Lake Nursery (land improvements, water system, equipment)	2,600.00
Nursery Stock (Trout Lake)	9,385.00
Nursery Stock (Tomahawk Lake)	1,985.00
Implements, tools and equipment	4,100.00
1000 acres of forest plantations	6,000.00
Total	$61,160.00

Recapitulation of Inventory.

Fisheries Division	$222,400.00
Warden Division	13,130.00
State Parks Division	335,554.00
Forestry Division (lands not included)	61,160.00
Grand Total	$632,744.00

Lands Under Direct Control. (Acreage)

Fish hatcheries	900
State Parks	6,469
Forest county game refuge	42,080
State Game Farm	300
Brule Forest Reserve	4,321
U. S. Forest Reserve grant	14,027
State Forestry lands	341,228
U. S. Grant Islands (637)	875
Indian Reservation Lands (claimed by state)	47,000
Total acreage	457,200

CLASSIFICATION OF CONFISCATIONS.

July 1, 1915, to June 30, 1916.

Seizures of:

Doe carcasses	23
Venison in closed season	29
Venison without coupon attached	1
Of live deer, closed season	4
More than lawful amount of venison	1
Dogs running deer	2
Deer heads or hides	21
Small game unlawfully in possession	3
Small game in transportation	2
Beaver hides	2
Otter hides	1
Illegal furs	60

More than bag limit of ducks	3
Ducks unlawfully in possession	4
Fish in closed season	13
Fish illegally transported	66
Fish illegally caught	18
Fish, undersized	32
Illegal nets	53
Fish, unlawfully labelled	3
Set lines, illegal	11
Snag lines	4
Boats	9
Guns	29
Traps	7
Spears	7
Fishing rods or creels	2
Duck decoys	2
Rabbits and ferrets	3
Pelicans	1
Total number of seizures	416

Amount realized from sale of confiscated goods, $2,730.48.

AMOUNT OF FINES AND COSTS IMPOSED ACCORDING TO COUNTIES, FROM JULY 1, 1915, TO JULY 1, 1916.

	Fines.	Costs.
Adams	$ 100.00	$ 9.76
Ashland	205.00	31.21
Barron	630.00	118.20
Bayfield	320.00	61.05
Brown	415.00	199.87
Buffalo	50.00	10.45
Burnett	30.00	
Chippewa	190.00	43.65
Clark	100.00	10.12
Columbia	150.00	19.74
Crawford	125.00	10.80
Dane	415.00	19.95
Dodge	555.00	103.14
Door	75.00	12.34
Douglas	585.00	49.78
Dunn	10.00	2.35
Eau Claire	1,390.00	92.55
Florence	200.00	49.10
Fond du Lac	265.00	108.77
Forest	125.00	36.14
Grant	75.00	7.50
Green	120.00	19.31
Green Lake		5.60
Iowa	95.00	13.03
Iron	135.00	20.70
Jackson	25.00	2.18
Jefferson	200.00	45.69
Juneau	370.00	129.50
Kenosha	110.00	89.04
Kewaunee	100.00	6.28
La Crosse	50.00	7.05
Lafayette	245.00	34.35
Langlade	100.00	8.00
Lincoln	495.00	104.10
Manitowoc	150.00	17.64
Marathon	285.00	86.30
Marinette	1,135.00	576.24
Marquette	$ 75.00	$ 8.82
Milwaukee	90.00	15.52
Monroe		
Oconto	120.00	55.79
Oneida	297.50	63.57
Outagamie	400.00	52.68
Pierce	70.00	3.10
Pepin	25.00	.75
Polk	1,125.00	158.83
Portage	50.00	21.22
Price	75.00	14.52
Racine	25.00	22.86
Richland	330.00	37.47
Rock	270.00	29.78
Rusk	260.00	28.70
St. Croix	25.00	2.30
Sauk	110.00	46.94
Sawyer	150.00	26.77
Shawano	25.00	10.35
Sheboygan	117.00	49.15
Taylor	100.00	9.29
Trempealeau	50.00	7.56
Vernon	50.00	6.89
Vilas	400.00	53.55
Walworth	310.00	45.36
Washburn	395.00	56.62
Washington	420.00	102.27
Waukesha	485.00	145.89
Waupaca	430.00	160.93
Waushara	75.00	39.99
Winnebago	890.00	76.62
Wood	100.00	23.08
Total	$16,969.50	$3,538.65

Total amount of warden's fees collected $554.75

ITEMIZED STATEMENT OF ARRESTS FROM JULY 1, 1915, TO JULY 1, 1916.

Transferring license	3
Resident hunting without license	32
Nonresident hunting without license	3
Hunting or killing deer in closed season	44
Killing or having doe in possession	20
Venison in possession in closed season	38

Buying or selling venison	14
Killing more than one deer	4
Hunting deer with dogs or having dogs in camp	11
Serving venison in camp or to borders,	4
Dynamiting fish	33
Unlawful method of fishing	102
Using fish trap	2
Catching and retaining undersized fish	28
Selling, catching or having game fish in possession in closed season	38
Catching game fish with dip net	20
Shipping more than 20 lbs. of fish in 7 days	3
Shipping more than 25 lbs. bullheads	3
Illegal transportation of fish	13
Using snag lines	7
Unlawful fishing within 200 feet of dam	3
Unlawful use of nets or seines	102
Unlawful use of set lines	26
Fishing without license, outlying waters	1
Fishing with lines unattended	6
Unlawful transportation of small game	4
Hunting or killing game birds in closed season	32
Killing more than fifteen ducks	4
Shooting ducks from motor boat	5
Shooting ducks in open water	33
Shooting ducks at night	44
Buying and selling game birds	4
Killing harmless birds or disturbing nests	26
Killing rabbits or squirrels in closed season	11
Hunting rabbits with ferret	10
Trapping in closed season	38
Trapping without license	2
Trapping beaver	4
Possessing otter	1
Shooting or spearing muskrats and mink	11
Molesting muskrat houses or trapping therein	23
Possessing green furs in closed season	23
Killing raccoon in closed season	6
Interfering with conservation warden	1
False labelling of shipments	2
Depositing deleterious substance in streams	4
Obtaining bounty by fraud	7
Issuing false certificates for bounty	11
Running Dogs in closed season for birds	2
Nonresident fishing without license	12
Setting poison without posting notice	1
Having venison without coupon attached	2
Total	883

Fine sentences imposed	594
Jail sentences imposed	52
Both fine and jail sentences imposed	5
Cases pending	37
Cases dismissed	41
Acquittals	31
Fine suspended on payments of costs	77
Both fine and costs suspended	30
Placed on probation	16
Total	883

STATEMENT OF ARRESTS AND SEIZURES BY WARDENS.

Arrests	Seizures	Warden	Address
8	1	Berg, M. E.	Rhinelander, Wis.
12	2	Berschens, M. L.	Madison
5	8	Barnhardt, Wm.	Sturgeon Bay
26	13	Boomer, I. H.	Oshkosh
1	....	Bernett, George	Tomah
8	....	Bosworth, E. F.	Merrill
10	1	Buell, V. C.	Appleton
11	5	Brunet, A. R.	Fond du Lac
5	3	Childs, A. S.	Ashland
16	18	Cranston, D. M.	Green Bay
6	1	Cole, W. A.	Vesper.
5	3	Curtis, P. S.	Viroqua.
12	5	Devine, Thos.	Spooner.
10	3	Diedrich, Peter	Milwaukee, 491 Superior.
32	17	Fisher, F. W.	Gillett.
11	4	Fosnot, John B.	Tomahawk.
16	2	Foster, John W.	Wausau.
10	4	Gautsch, E. W.	La Crosse.
23	8	Grey, W. T.	Rice Lake.
18	8	Gruebner, H. C.	Sheboygan.
14	8	Hall, A.	Darlington.
20	3	Hall, George F.	Rubicon.
4	4	Holmes, A. A.	Trempealeau.
6	8	Hope, Andrew	Hammond.
8	4	Hull, G. F.	Wittenberg.
7	2	Jakoubek, K. C.	Phillips.
7	2	Keeler, J. G.	Bagley.
18	2	Kelsey, J. V.	Stevens Point.
12	2	Keys, W. A.	Princeton.
15	9	Kleist, Mike	Oshkosh and Green Bay.
15	10	Lanning, B. P.	Black River Falls.
30	4	Lee, Albert	Luck.
10	2	Long, John	Mellen.
1	2	Little, C. S.	Stanley.
22	4	Mason, W. P.	Janesville.
12	7	McNaughton, Jas.	Superior.
15	5	Miller, G. A.	Boscobel.
12	5	Nolan, R. B.	Sextonville.
21	6	Oberholtzer, H. J.	Eagle River.
7	6	Powell, A. W.	Bayfield.
9	5	Pooler, W. D.	Superior.
15	1	Pugh, John	Racine.
9	2	Randall, F. D.	Waupaca.
10	76	Raeth, Val	Milwaukee, 1178 Humboldt.
5	7	Richtman, S. P.	Fountain City.
6	1	Russell, A. G.	Wabeno.
7	8	Russell, Frank	Park Falls.
24	5	Sampson, Andrew	Stoughton.
62	20	Smith, Denton	Marinette.
14	3	Soule, L. M.	Ladysmith.
11	13	Stahl, Geo.	Green Bay, Box 208.
3	2	Swant, M. F.	Menomonie.
17	3	Thorn, M. C.	Wausau.
14	8	Tiedeman, H. C.	Thorp.
28	7	Tuttle, E. W.	Oconomowoc.
9	4	Wismer, W. W.	Drummond.
11	1	Worden, John D.	Plainfield.
22	2	Fess, Edw.	Madison, 4 months.
5	7	Cadrant, J. J.	Green Bay, 3 months.
3	....	Gwidt, Steve	Marinette, 3 months.
4	2	Jeske, Louis	Madison, 2 months.

DISTRIBUTION OF FISH.

SUMMARY OF OUTPUT OF HATCHERIES, 1915.

Madison Hatchery:	
Brook trout, advanced fry	1,207,800
Rainbow trout, advanced fry	2,046,800
Rainbow trout, yearling	3,800
Brook trout, adult	1,800
Rainbow trout, adult	2,150
Furnished trout for State Fair Exhibit	300
	3,262,650
Bayfield Hatchery:	
Brook trout, advanced fry	3,107,800
Rainbow trout, advanced fry	830,000
Brook trout, fingerling	63,200
Rainbow trout, fingerling	146,700
Lake trout fry	13,977,500
Bluefin fry	17,280,000
Brook trout eggs	50,000
Brook trout, fingerling sent to Madison and Wild Rose Hatcheries	15,500
Brook trout, adult	2,805
Rainbow trout, adult	547
Furnished trout for fairs and aquariums	250
	35,474,302
Oshkosh Hatchery:	
Wall-eyed pike fry	18,000,000
Wall-eyed pike eggs at the point of hatching	12,600,000
	30,600,000
Minocqua Hatchery:	
Wall-eyed pike fry	41,078,000
Black bass fry	50,000
Pickerel fry	300,000
Muskellunge fry	600,000
Bullheads, adult	145
	42,028,145
Delafield Hatchery:	
Wall-eyed pike fry	36,200,000
Black bass, fingerling	168,000
	36,378,000
Wild Rose Hatchery:	
Brook trout, advanced fry	1,675,000
Rainbow trout, advanced fry	1,909,200
Rainbow trout, yearling	8,200
	3,592,400
Sturgeon Bay Hatchery:	
Lake trout fry	17,346,000
Whitefish fry	4,400,000
	21,746,000
Sheboygan Hatchery:	
Lake trout fry	14,511,220
Bluefin fry	9,900,000
Lake trout, eyed eggs	100,000
	24,511,220
Spooner Hatchery:	
Wall-eyed pike fry	18,904,000
Eagle River Hatchery:	
Wall-eyed pike fry	28,350,000
Mississippi River:	
Croppies and Sunfish, fingerling	20,600
Pike and Bass, fingerling	12,875
Pickerel, fingerling	10,300
Rough fish, fingerling	7,725
	51,300
Neenah:	
Perch, fingerling	81,360
Lake trout eggs impregnated	1,176,500
State Fair Exhibit	330
Total	246,156,407

DISTRIBUTION OF FISH.

RECAPITULATION OF FISH DISTRIBUTED, 1915.

Brook trout, advanced fry	5,990,600
Brook Trout, fingerling	63,200
Rainbow trout, advanced fry	4,786,000
Rainbow trout, fingerling	146,700
Wall-eyed pike fry	142,532,000
Black bass fry	50,000
Black bass, fingerling	178,000
Muskellunge fry	600,000
Pickerel fry	300,000
Lake trout fry	45,834,720
Lake trout, impregnated eggs	1,176,500
Whitefish fry	4,400,000
Bluefin fry	27,180,000
Perch, fingerling	81,360
Miscellaneous	12,785,827
Mississippi river, miscellaneous	51,500
	246,156,407

SUMMARY OF OUTPUT OF HATCHERIES, 1916.

Madison Hatchery:	
Brook trout, advanced fry	1,172,000
Rainbow trout, advanced fry	1,563,600
Brook trout, adult	2,000
Furnished fairs and aquariums	40
	2,737,640
Bayfield Hatchery:	
Brook trout, advanced fry	2,986,200
Rainbow trout, advanced fry	628,800
Lake trout fry	10,686,000
Rainbow trout, adult	1,034
Furnished fairs and aquariums	320
	14,302,354
Oshkosh Hatchery:	
Wall-eyed pike fry	1,350,000
Minocqua Hatchery:	
Wall-eyed pike fry	26,404,000
Black bass fry	416,000
Pickerel fry	900,000
Muskellunge fry	800,000
	28,520,000
Delafield Hatchery:	
Wall-eyed pike fry	28,550,000
Black bass, fingerling	448,000
Black bass, yearling	8,247
Roach, fingerling	5,100
Black bass, yearling to State Fair	312
	29,011,659
Wild Rose Hatchery:	
*Brook trout, advanced fry	100,000
Rainbow trout, advanced fry	1,861,800
Furnished fairs and aquariums	12
	1,961,812
Sturgeon Bay Hatchery:	
Lake trout fry	12,180,000
Sheboygan Hatchery:	
Lake trout fry	16,042,080
Whitefish fry	4,074,070
Chub fry	18,480,000
Bluefin fry	5,092,000
	43,688,150
Spooner Hatchery:	
Wall-eyed pike fry	17,438,400
Eagle River Hatchery:	
Wall-eyed pike fry	28,800,000
Tenney Park Hatchery:	
Wall-eyed pike fry	26,240,000
Neenah: Whitebass and Perch, fingerling	73,990
Weyauwega: Pickerel, fingerling	3,000
Hayward: Croppies fingerling	1,150
State Fair Exhibit	330
Total	206,308,485

RECAPITULATION OF FISH DISTRIBUTED, 1916.

Brook trout, advanced fry	4,258,200
Rainbow trout, advanced fry	4,054,200
Wall-eyed pike fry	128,782,400
Black Bass fry	416,000
Black bass, fingerling	448,000
Black bass, yearling	8,247
Muskellunge fry	800,000
Pickerel fry	900,000
Lake Trout fry	38,908,080
Whitefish fry	4,074,070
Chub fry	18,480,000
Bluefin fry	5,092,000
Whitebass and Perch, fingerling	73,990
Pickerel, fingerling	3,000
Croppies, fingerling	1,150
Roach, fingerling	5,100
Miscellaneous	4,048
	206,308,485

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*2,000,000 eyed brook trout eggs sent to Bayfield.

DISTRIBUTION BY COUNTIES

1915.

County.	Brook Trout Advanced Fry	Rainbow Trout Advanced Fry	Brook Trout Fingerling	Rainbow Trout Fingerling	Wall-eyed Pike Fry	Black Bass Fry	Black Bass Fingerling	Perch Finger-ling.
Adams	10,800	23,800						
Ashland	118,800	209,000		12,400	1,936,000			
Barron	93,600	88,400	2,100	5,600	1,902,000			
Bayfield	577,000	398,000	5,570	22,800	4,428,000			
Brown	73,800	37,200						
Buffalo								
Burnett	3,600	4,800			2,000,000			
Calumet		8,400			950,000			
Chippewa	91,800	84,200	600		492,000			
Clark	10,800	41,400	2,100					
Columbia	93,600	72,800			3,266,000			4,800
Crawford	48,600	11,200						
Dane	135,000	112,000			6,436,000		5,000	960
Dodge	7,200	4,200			1,400,000			4,520
Door	23,400	21,600			408,000			
Douglas	147,600	92,800	2,700	19,800	1,240,000	6,000		
Dunn	140,400	61,600		1,600	740,000			
Eau Claire	82,800	49,000						960
Florence	57,600	51,800			570,000			
Fond du Lac	37,800	10,800			646,000		5,000	3,160
Forest	171,000	76,000		4,800	1,796,000	6,000		840
Grant	70,200	39,200		1,200				
Green	64,800	36,400			204,000			350
Green Lake	25,200	4,200			450,000			
Iowa	77,400	30,800				6,000		
Iron	120,600	35,200			1,368,000			
Jackson		132,000	17,100	11,000	476,000			1,920
Jefferson	19,800	9,800	450		2,834,000		6,000	5,160
Juneau	73,800	33,600			1,250,000			
Kenosha					1,690,000		11,000	2,160
Kewaunee	39,600	59,400						
La Crosse	39,600		4,200		1,200,000			
La Fayette	18,800	4,200					6,000	490
Langlade	28,800	30,000		4,800	1,786,000	2,000		
Lincoln	115,200	25,200			2,812,000			
Manitowoc	54,000	104,400			1,064,000			420
Marathon	145,800	145,800	2,400		1,216,000			
Marinette	286,200	260,400		4,800	3,524,000			
Marquette	39,600	33,600			1,200,000			
Milwaukee					120,000			
Monroe	124,200	127,400	4,200		800,000			
Oconto	75,600	74,200			646,000			960
Oneida	55,800	18,200			18,048,000	10,000		960
Outagamie	5,400							
Ozaukee		8,400			320,000		5,000	1,680
Pepin								
Pierce	111,600	75,600		8,400				
Polk	36,000	56,600			1,066,000			
Portage	131,600	156,600			984,000			1,800
Price	57,600	66,600			2,040,000			
Racine	10,800				1,242,000		8,000	1,920
Richland	70,200	85,400		8,200	200,000			
Rock	27,000				1,506,000			3,000
Rusk	115,200	81,000		4,800	1,164,000			
St. Croix	118,800	91,200		10,400	396,000			

DISTRIBUTION BY COUNTIES

1915.

County	Brook Trout Advanced Fry	Rainbow Trout Advanced Fry	Brook Trout Fingerling	Rainbow Trout Fingerling	Wall-eyed Pike Fry	Black Bass Fry	Black Bass Fingerling	Perch Fingerling.
Sauk	77,400	29,400			3,000,000			
Sawyer	55,800	22,400		3,600	1,756,000			
Shawano	252,800	159,200			2,728,000	2,000		960
Sheboygan		51,400	2,700		1,446,000		15,000	1,380
Taylor	10,800	27,200			1,258,000			
Trempealeau	91,800	170,800	12,000	16,800	340,000			2,760
Vernon	91,800	36,400	3,300	5,600				
Vilas	54,000	101,800			28,858,000	12,000		
Walworth	37,800	5,600			3,348,000		9,000	2,760
Washburn	61,200	51,200			6,672,000	12,000		
Washington	12,600				1,582,000		5,000	4,680
Waukesha	95,400	39,200			6,672,000		91,000	3,840
Waupaca	133,200	77,400			934,000			960
Waushara	854,000	670.400	3,600		1,310,000		5,000	
Winnebago					3,078,000			27,000
Wood	77,400	68,400			1,632,000			960
Total	5,990,600	4,786,000	63,200	146,700	142,532,000	50,000	178,000	81,360

DISTRIBUTION BY COUNTIES

1916.

County	Brook Trout Advanced Fry	Rainbow Trout Advanced Fry	Wall-eyed Pike Fry	Black Bass Fry	Black Bass Fingerling	White Bass & Perch Fingerling
Adams	54,000	24,000				
Ashland	144,000	166,800	1,722,000			
Barron	120,600	73,600	1,688,400			
Bayfield	329,400	209,600	3,791,600			
Brown	45,000	7,200				
Buffalo	36,000	9,600				
Burnette	14,000	16,000	453,600			
Calumet	26,000					
Chippewa	25,200	64,000	592,200			
Clark	36,000	27,000				
Columbia	80,000	57,600	1,212,000			1,200
Crawford	25,200	41,600				
Dane	113,200	163,600	15,840,000		35,000	
Dodge	18,600	6,400	300,000		20,000	3,600
Door	18,000	5,400				
Douglas	167,400	46,400	2,468,400	24,000		
Dunn	111,600	49,200	1,042,600			
Eau Claire	122,400	24,000	327,600			1,200
Florence	36,000	54,000	780,000			
Fond du Lac	37,800	21,600	400,000			3,900
Forest	84,600	81,600	2,294,000			
Grant	68,000	68,800				
Green	46,000	28,800				
Green Lake	5,400	5,400	200,000			12,000
Iowa	48,000	12,800				
Iron	91,800	16,000	2,162,000	28,000		
Jackson	10,800	104,000	138,000			
Jefferson	19,200	16,000	3,842,000		30,000	2,400
Juneau	6,000	25,600	1,384,000			
Kenosha		7,200	900,000			1,920
Kewaunee	102,000	79,200	506,000			
La Crosse		28,800	1,200,000			
La Fayette	14,000		250,000		Y. 300	
Langlade	46,800	5,400	1,886,000	24,000		1,040
Lincoln	64,000	50,400	1,196,000	36,000	Y. 1,200	1,200
Manitowoc	37,200	32,400	598,000			1,440
Marathon	64,200	113,400	1,334,000	12,000		1,200
Marinette	194,800	238,400	1,500,000			
Marquette	120,000					
Milwaukee						
Monroe	30,000	73,600	500,000			
Oconto	66,000	91,800	368,000			
Oneida	94,800	16,000	13,224,000	136,000		1,200
Outagamie						
Ozaukee	6,000	16,000				
Pepin						
Pierce	102,600	38,400				
Polk	61,200	4,800	575,200			
Portage	46,400	100,800	1,100,000			4,480
Price	101,600	124,000	2,100,000			
Racine	12,000		642,000		4,000	2,160
Richland	32,000	51,200				
Rock	36,800	38,400	1,600,000		24,000	2,640
Rusk	61,200	124,800	598,000			
St. Croix	126,000	51,000	403,200			
Sauk	44,000	32,000	2,304,000			1,200
Sawyer	82,800	85,000	1,658,400			1,440
Shawano	243,000	174,400	1,196,000			3,180
Sheboygan	8,000	7,200	700,000			1,440
Taylor	30,600	17,200	1,500,000			

DISTRIBUTION BY COUNTIES

1916.

County	Brook Trout Advanced Fry	Rainbow Trout Advanced Fry	Wall-eyed Pike Fry	Black Bass Fry	Black Bass Fingerling	White Bass & Perch Fingerling
Trempealeau	36,000	88,000	552,000			
Vernon	18,000	48,000				
Vilas	43,200	90,000	17,413,000	132,000		
Walworth	32,000		3,062,000		4,000	5,340
Washburn	73,800	20,800	7,055,200	24,000	Y. 500	1,200
Washington	6,000	15,600	3,696,000		Y. 400 16,000	3,240
Waukesha	56,000	26,400	7,192,000		Y. 4,847 303,000	4,440
Waupaca	82,000	108,000	1,418,000			1,730
Waushara	143,000	523,800			Y. 1,000	
Winnebago			8,951,000			19,000
Wood	12,000	104,400	966,000			
Total	4,258,200	4,054,200	128,782,400	416,000	448,000 Y. 8,247	73,990

Y. Yearling.

Hatchery	Kind of fish	Mature	. of fry atched	No. of fry lost	No. of fry retained	No. of fry distributed	Total fish distributed from hatchery
Madison	Brook trout	7,500	325,000	3,000	150,000	1,172,000	
	Rainbow trout	15,000	635,000	21,400	50,000	1,563,600	
	Miscellaneous					2,040	
							2,737,640
Bayfield	Brook trout	12,000	305,169	18,969	200,000	2,986,200	
	Rainbow trout	7,822	820,000	41,438	150,000	628,800	
	Brown trout	308	ok trout				
	Lake trout		686,000			10,686,000	
	Miscellaneous					1,354	
							14,302,354
Oshkosh	Wall-eyed pike		350,000			1,350,000	1,350,000
Minocqua	Wall-eyed pike		000,000	596,000		26,404,000	
	Black bass	486				416,000	
	Pickerel fry		900,000			900,000	
	Muskellunge		800,000			800,000	
							28,520,000
Delafield	Wall-eyed pike		550,000			28,550,000	
	Black Bass Fingerling					448,000	
	Black Bass Yearling					8,247	
	Roach					5,100	
	Miscellaneous					312	
							29,011,659
Wild Rose	Brook trout	5,900	416,000	16,500	300,000	100,000	
	Rainbow trout	12,500	448,050	87,050	500,000	1,861,800	
	Brown trout	700	15,000		15,000		
	Miscellaneous					12	
							1,961,812
Sheboygan	Lake trout		042,080			16,042,080	
	Whitefish		074,070			4,074,070	
	Bluefin		092,000			5,092,000	
	Chubs		480,000			18,480,000	
							43,688,150
Sturgeon Bay	Lake trout		180,000			12,180,000	12,180,000
Spooner	Wall-eyed pike		550,000	112,000		17,438,400	17,438,400
Eagle River	Wall-eyed pike		800,000			28,800,000	28,800,000
Tenney Park	Wall-eyed pike		550,000	310,000		26,240,000	26,240,000
Neenah	White Bass and Perch fingerling						73,990
Weyauwega	Pickerel fingerling						3,000
Hayward	Croppies fingerling						1,150
State Fair Exhibit							330
							206,308,485

STATISTICS ON COMMERCIAL FISHING INDUSTRY
LAKE MICHIGAN AND GREEN BAY.
YEAR—1915.

Port	Pounds	Value
Kenosha	272,516	$16,083.12
Racine	328,345	31,792.57
Milwaukee	1,915,011	102,094.80
Port Washington	505,371	35,527.20
Cedar Grove	160,145	6,623.90
Oostburg (including Thiensville)	91,970	3,466.69
Sheboygan	834,602	54,524.88
Manitowoc	104,954	3,046.29
Two Rivers	767,879	44,373.40
Algoma	333,129	21,239.48
Kewaunee	188,405	7,602.74
Luxemburg	63,661	2,469.64
Sturgeon Bay & Sawyer	708,976	26,038.00
Ports above Sturgeon Bay	2,725,478	91,934.50
Brussels	765,815	30,171.74
Suamico & Little Suamico	1,117,768	28,749.68
Green Bay (City)	3,186,556	73,508.06
De Pere	263,606	6,909.69
Marinette and Peshtigo	1,613,562	37,671.89
Oconto	1,496,964	32,625.63
Pensaukee	1,145,268	23,415.52
	18,590,071	$679,869.42
VARIETY		
Whitefish	120,916	10,561.98
Lake Trout	3,850,765	277,681.29
Bluefin	730,372	15,043.72
Chubs	2,542,481	112,333.91
Herring	5,530,305	96,943.66
Pike	179,395	14,592.39
Bass	14,854	593.49
Perch	2,349,168	69,578.00
Rough Fish	3,271,815	73,329.12
Crawfish (2,635,485)	....	9,211.86
	18,590,071	$679,869.42

Number of reports	639
Number of men employed	1,249
Number of row boats, 292; value	$5,690.00
Number of power boats, 320; value	154,878.00
Feet of gill net, 12,533,665; value	228,449.50
Fyke nets, 1,469; value	33,420.00
Pound nets, 330; value	63,743.00
Trammel nets, 27; value	820.00
Set hooks (feet), 2, 328,660; value	7,145.75
Feet of seine, 36,640; value	3,553.00
Number of crab nets, 975; value	185.00
Number of tugs, 58; value	180,400.00
Sail boats, 3; value	97.00
Total	$678,381.25

STATISTICS ON COMMERCIAL FISHING INDUSTRY

LAKE SUPERIOR.

YEAR—1915.

	Pounds	Value
Whitefish	43,187	$3,516.36
Lake Trout	511,443	28,274.11
Bluefin	3,783	184.10
Herring	1,904,202	16,344.15
Pike	49,315	5,428.13
Perch	89	6.14
Rough Fish	166,018	3,478.37
Sturgeon	2,673	302.07
	2,680,710	$57,533.43

Number of men employed, 163.	
Number of row boats, 48; value	$1,072.00
Number of power boats, 48; value	24,115.00
Feet of gill nets, 1,163,100; value;	24,371.00
Number of fyke nets, 2; value	150.00
Number of pound nets, 49; value	5,425.00
Feet of set hooks, 72,200; value	400.00
Number of tugs, 2; value	5,000.00
Number of sail boats, 2; value	1,875.00
Total	$62,408.00

STATISTICS ON COMMERCIAL FISHING INDUSTRY

MISSISSIPPI RIVER.

YEAR—1915.

Specie	No. Pounds	Value
Buffalo	388,214	$20,216.83
Carp	560,864	21,361.90
Bullheads and Catfish	60,090	6,256.26
Sturgeon or spoonbill	6,066	655.66
Sheephead	164,895	3,885.80
Red Horse	4,957	172.29
Gar and Dogfish	70,834	632.78
Eel Pout		
Suckers	24,909	677.74
Total	1,280,829	$53,859.26

*Out of 177 licenses issued, about 30 failed to render reports.

RECAPITULATION ON COMMERCIAL FISHING INDUSTRY.

YEAR—1915.

	Pounds	Value	Investment
Lake Michigan and Green Bay	18,590,071	$679,869.42	$678,381.25
Lake Superior	2,680,710	57,533.43	62,408.00
Mississippi river	1,280,829	53,859.26	55,260.00
Rough fishing inland waters	1,381,168	55,246.72	25,000.00
Total	23,932,778	$846,508.83	$821,049.29

MUSKRAT FUR INDUSTRY.

Number of fur farm licenses issued	118
Licenses issued in Winnebago county	84
Licenses issued in balance of state	34
Greatest number of furs sold under one license	*12,125
Total number of furs reported sold (amount received $27,304.25)	63,459

*Reported by C. H. Sherburne, Fremont, Wisconsin

SUMMARY OF FISH PLANTED BY WISCONSIN SINCE 1877.

Year.	Brook trout.	Rainbow trout.	Salmon.	Carp.	White-fish.	Lake trout.	Wall-eyed pike.	Black bass.	White bass.	Muskel-lunge.	Pickerel.	Yellow perch.	Miscel-laneous.	Total.
1877–1880	1,202,259		233,510		25,945,000	35,257,000								36,335,969
1881	1,988,900			°163										1,088,163
1882	828,590				6,000,000									6,828,500
1883	1,339,000				16,000,000		8,000,000							25,330,000
1884	2,605,000	95,000		°253	17,000,000		9,700,000							38,800,000
1885	1,510,000	600,000		°6,765			14,500,000							16,616,765
1886	2,275,000	630,000		°556	33,210,000		3,450,000							39,571,556
1887	2,900,000	1,345,000		°17,165	31,500,000	500,000	8,800,000							45,093,165
1888	2,285,000	1,590,000		°25,512	18,000,000	700,000	4,450,000							27,050,512
1889	2,190,000	2,615,000		5,230	30,000,000	5,850,000	14,050,000							54,710,230
1890	3,320,000	3,460,000		°35,591	27,472,500	*27,472,500	14,680,000							76,568,091
1891	2,620,000	2,415,000		°9,855	35,000,000	*1,536,000	6,000,000		5,200,000					52,780,855
1892	3,245,000	3,340,000		°8,700	14,000,000	*10,704,000	13,595,000							44,872,700
1893	1,635,000	1,675,000		°5,050	35,000,000	*14,249,000	5,500,000	°29,000						58,096,050
1894	3,785,000	2,605,000		°8,125	33,000,000	*10,777,000	9,600,000	°73,000	§4,960					59,853,085
1895	2,556,000	1,470,000		°8,525	15,000,000	*22,100,000	23,100,000	°116,000	§2,345					64,275,770
1896	3,110,000	1,611,000			27,500,000	†22,710,000	25,250,000	°156,634	§13,500					69,120,089
1897	1,949,000	1,241,000			18,000,000	‡10,010,000	23,300,000	°4,400	§9,115	1,100,000				55,613,615
1898	1,852,500	1,180,000			3,000,000	7,362,900	53,980,000	°112,200	§23,420					67,760,120
1899	2,208,000	1,005,500				16,848,000	60,190,000	°68,665	§15,100					80,455,755
1900	2,393,000	1,653,000				30,797,500	69,850,000			100,000	7,090,000			111,793,500
1901	1,866,500	1,068,500			34,450,000	19,980,000	78,200,000	°44,270		472,500	*5,840,000			132,921,770
1902	2,569,000	1,299,000			66,820,000	17,877,000	37,325,000	°10,200		80,000				126,150,200
1903	1,512,500	1,050,000			37,500,000	16,168,000	49,170,000	°318,000		100,000	*2,080,000		200,125	105,089,625
1904	2,090,000	2,283,750			20,375,000	20,463,000	37,825,000	‡549,900		50,000			100,200	83,737,850
1905	2,937,000	1,362,000			15,278,000	18,803,000	76,800,000	‡341,300	°1,463,000	50,000		°723,880	252,700	118,010,980
1906	2,442,500	1,673,000			53,780,000	16,197,500	79,140,000	‡940,550	°3,500	800,000	*5,180,000	°18,000	23,575	160,409,125
1907	**1,980,000	1,558,500			27,025,000	19,724,000	44,900,000	‡409,500	°1,250	420,900	†2,870,000		146,026	99,034,276
1908	**2,272,000	2,098,500			12,210,000	12,345,000	112,075,000	‡779,800		†452,000	5,859,000		1,255,769	149,338,009
1909	**2,460,000	**2,358,800	Bluefin		17,720,000	22,282,000	85,010,000	‡1166,400	°1,000	†920,000	1,920,000		8,227,190	142,065,390
1910	**3,323,800	**2,616,500			1,600,000	25,650,600	70,990,000	‡851,700		76,000	600,000		1,156,098	106,864,698
1911	**4,898,000	**3,088,000	4,375,000		3,750,000	32,034,080	121,750,000	1,400,200		200,000	580,000		514,255	172,590,535
1912	**7,250,400	**2,719,200	3,150,000		10,080,000	22,174,167	153,240,000	236,762		125,000	2,405,250		867,523	180,074,135
1913	**6,543,000	**4,090,000 [1]15,625	28,000,000 [1]15,625	Bullhead °23,000	5,000,000	21,925,300 *4,680,000	115,690,000 *42,790,000	1,212,000 °544,925	°58,500	100,000	2,300,000 °12,375		1,179,390	234,164,115
1914	**6,830,600	**5,206,500 °70,250	14,760,000 *12,000,000		5,720,000	38,762,000 *8,000,000 [3]360,000	149,797,000	762,000 **647,000 °8,000	°49,000 [2]41,250	225,000	750,000	°129,100	2,962,176	247,079,876
1915	**5,990,600 °63,200	**4,786,000 [b]146,700	27,180,000	Chub	4,400,000	45,834,720 *1,176,500	142,532,000	50,000 °178,000		600,000	300,000	°81,360	12837,337	246,156,407
1916	**4,258,200	**4,054,200	5,092,000	18,480,000	4,074,070	38,908,080	128,782,400	416,000 °448,000 [1]8,247	°36,995 [4]1,150 [5]5,100	800,000	900,000 °3,000	°36,995	4,048	206,308,485

* Impregnated eggs. † Eggs and fry. ‡ Fry and fingerlings. § Adult fish. ° Fingerlings. ** Advanced fry.
[1] Yearling. [2] White bass and perch fingerling. [3] Green Bay trout. [4] Croppies. [5] Roach.
Note—Fish planted in fry stage unless otherwise indicated.

8

STATE OF WISCONSIN

CONSERVATION COMMISSION

MADISON

JAMES NEVIN, Chairman

W. E. BARBER, F. B. MOODY,

R. S. SCHEIBEL, Secretary

FISHERIES
FORESTRY
STATE PARKS
FISH AND GAME PROTECTION

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PROPERTY OF DIVISION OF FORESTRY
COLLEGE OF AGRICULTURE
UNIVERSITY OF CALIFORNIA

FOREST PLANTING IN WISCONSIN

By

W. D. BARNARD, Forest Assistant

INTRODUCTION.

Raising timber in Wisconsin means increased prosperity and the maintenance of all the useful influences of forests. The importance of forest planting is now recognized throughout the timber states and results attained from older plantations in various states have been highly satisfactory. This pamphlet has been prepared because of the increasing interest in reforestation in Wisconsin and in order to meet the need of more specific information on the subject. Its scope is necessarily limited to planting of forests and does not extend to ornamental planting.

Raising merchantable timber is not the sole incentive in forest planting. Besides the valuable wood material produced, forests conserve soil moisture, thus regulating stream flow, they furnish a refuge for wild life and healthful recreation grounds. A plantation only 10 or 15 years old will contribute very largely to the beauty of a site, and will afford an excellent refuge for wild life. A forest does not need to be of merchantable age to be valuable.

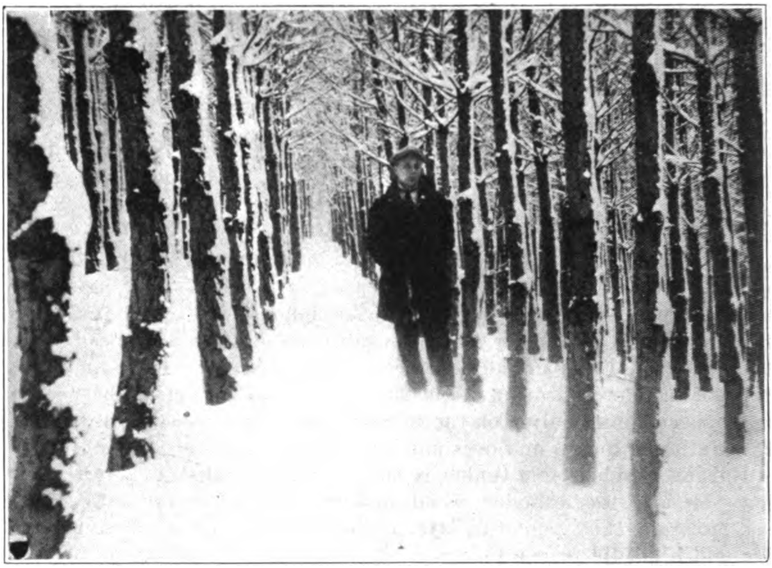
WHAT THE STATE HAS DONE.

Forest planting in Wisconsin is yet in its infancy. Extensive planting did not begin until 1911, when nearly 200 acres of state lands near Trout lake were planted to conifers. As there were no state nurseries in Wisconsin at that time, the first planting stock was purchased from commercial nurseries. The same year, however, a nursery was established at Trout lake and about 1,000,000 seedlings were raised.

In 1912, 10 acres more of the state lands near Trout lake were set with conifers, and the nursery was enlarged to 7 acres. A nursery of 4 acres was also established at Tomahawk lake.

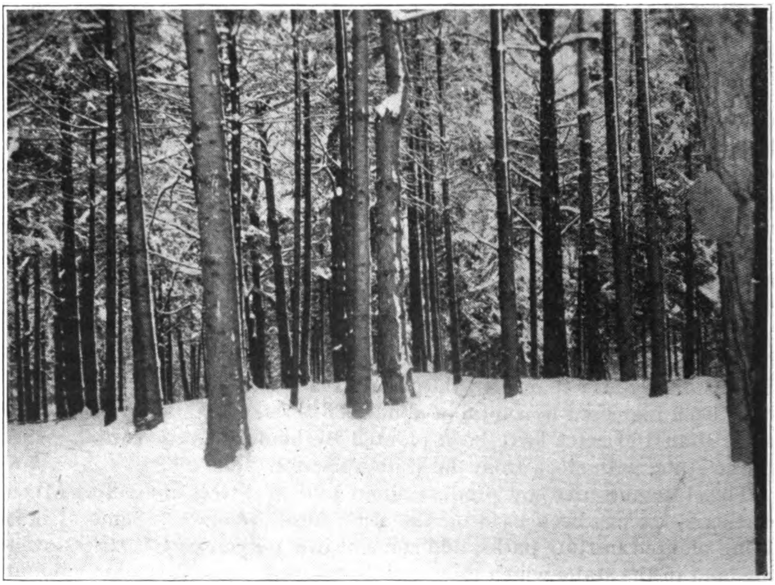
In the spring of 1913 some of the stock in the Trout lake nursery was large enough to set out, and operations were begun at Star lake and at Plum lake. Since that time the plantations on the state forest reserve have been increased to a total of about 900 acres, and in addition to this, more than 100 acres have been planted by landowners in various parts of the state, with stock from the state nurseries.

The state nurseries now produce about 1,000,000 trees annually. Much of this stock has been used on the state forest reserves. Some of it is being planted in state parks, and some of it is purchased by parties owning land in the state, which they wish to reforest. An increasing amount of the planting stock is being purchased annually for private planting, and it is certain that when the possibilities of forest planting are more fully realized, there will be a demand for as much stock as the state nurseries can furnish, or even more.



A SCOTCH PINE PLANTATION 23 YEARS OLD, MILBROOK, N. Y.

Average height 35′. Courtesy Forestry Dept., Cornell University.



NORWAY SPRUCE, WHITE PINE AND SCOTCH PINE PLANTED IN MIXTURE.

Forty years old. Grown from seed sown broadcast. Average height 55′. Courtesy Forestry Dept., Cornell University.

CONDITIONS THAT MAKE FOREST PLANTING ADVISABLE.

In Wisconsin, forest planting is usually advisable on lands of the following character:

Rough Land in Farms.

(1) Parts of farms which, because of their rough or rocky nature, thin or poor soil, inaccessibility, or other disadvantages, are suited only to forest growth. This class includes steep and rocky hillsides from which the top soil has eroded, gullies, borders of streams and the like, —land that will support good forest growth, but that produces little or no income when used for any other purpose.

Cut-over Land.

(2) Wild land from which all valuable forest growth has been removed, and which is unsuited for agriculture or is not yet needed for agriculture. Portions of the cut-over pine lands in the northern part of the state are a good example of this type.

Brush Land.

(3) Brush land such as abandoned fields and pastures, or other land that has grown up to worthless brush. Such land is bringing in no returns, but could be made valuable by planting desirable species of trees on it.

Timberland Incompletely Stocked.

(4) Timberland incompletely stocked, on which a full stand is desired, and which is not likely to be renewed by natural seeding.

Farm Woodlots.

(5) Farm woodlots which cannot be fully stocked within a reasonable time except by planting, or a treeless area to be added to the woodlot.

PREPARATION OF LAND.

Although a planting area often needs some preparation, it is rarely advisable to give the land the careful and expensive preparation such as is necessary for the growing of field crops. The treatment required depends entirely upon local conditions. In general, land planted with trees should be well protected from fire, grazing, or other agency that is likely to injure or retard the growth of the trees.

If the planting area has been logged and the slash has never been burned, it should in most cases be disposed of before any planting is attempted. If there is slash or other inflammable material on the ground, there is constant danger from fire unless the area is very small and is carefully guarded. Even under these conditions it is usually much the safer plan to dispose of the slash before planting.

Dead timber should, when practicable, be removed from the land to be planted. Dead and dying timber is not only very unsightly, but is likely to fall, injuring the young growth, and increasing the danger from fire. It also invites and harbors many species of insects, which may be very injurious to young growth.

TIME TO PLANT.

Spring Planting.

The best time for forest planting is in the early spring, as soon as the frost is out of the ground. The trees are then dormant. They will be damaged less by handling then than after the buds have swelled or the tender young shoots have started. If the buds and shoots are damaged, the trees will be deformed. This is especially true of conifers. After planting, the spring rains will further settle the soil about the tree roots and ideal growing conditions usually follow the disappearance of frost from the ground.

Late spring planting should be avoided. Not only does it do great damage to the trees, but the transferring of the trees stops root functions and root development at a time when they should be taking food from the ground. It checks the growth of the trees until they have become reëstablished in the ground. Trees planted late in the spring frequently do not become well established during the first season, and they may not thereafter begin a rapid growth on the new site for two and even three seasons.

Another factor that causes much loss in late spring planting is the loss of moisture from the leaves of the trees. This occurs in both broadleaf and coniferous species. When leaves are on the trees and the trees are active, there is a constant giving off of moisture from them. If during this time, the trees are disturbed so that the roots cannot take up a corresponding amount of moisture, the plants will die. In the late spring this evaporation of moisture from the leaves is increased by higher temperatures, and consequently there is likely to be a great loss of young plants.

Fall Planting.

Fall planting should not generally be practiced when it is possible to do the work in early spring. In spring the trees can adapt themselves to the new conditions immediately, but in the fall they will not become entirely adapted to the new conditions until growth begins the following year. Fall planting exposes the trees to injury, during the winter, from various agencies. Under no circumstances should fall planting be attempted on heavy clay soil.

Fall planting has been done, however, in a number of cases with a marked degree of success. In the state nursery at Trout lake, fall transplanting of conifers has been practiced for a number of years, and from the appearance of the trees, the work done in the fall cannot be distinguished from the work of the following spring. In the fall of 1914, 10 acres near Trout lake were planted to white, Scotch, and red pine. Another plot of 2 acres was planted to Norway spruce. The plantings of trees with compact, fibrous roots and small tops, namely white pines and Norway spruces, were very successful, between 85 per cent and 90 per cent having survived. In the case of the red and Scotch pines, which had large tops and less compact roots, the results were much less favorable, there being a survival of only 54 per cent. This was probably because there was an evaporation from the tops of more moisture than the small root system could replace.

Broadleaf deciduous species should not be transplanted while the leaves are on the trees. Fall planting of broadleaves is generally more successful than that of conifers. This is due to the fact that in fall planting, moisture may be lost from the leaves of conifers at a time when the roots have no means of compensating for this loss. While the loss of moisture at this time of year is not so great as when growth is taking place, yet there is always a small amount of evaporation from the leaves of coniferous trees. With broadleaves, evaporation in the fall of the year takes place only from the bark, and is comparatively slight.

SELECTION OF SPECIES.

Purpose of Planting.

The selection of species for planting is necessarily governed by a number of factors. The first of these factors is the purpose for which the timber is wanted. Many of the shade and ornamental species are of little value for commercial planting. Similarly, many species that are valuable for certain commercial purposes arc of little or no value for others. It is therefore practicable to plant species which, when large enough for use, meet the given requirements.

Character of Site.

Another factor is the character of the site. Although certain species may be desired, it will often be necessary to plant others, for the reason that the first may not be suited to local conditions. Species that demand good soil should not be planted on a poorer one. Neither should shade demanding species be planted on exposed situations. An inferior species should not be planted on a site where a more valuable one would thrive and yield greater returns. Species should be chosen that are well adapted to a site, and that will produce the most valuable material within a reasonable time.

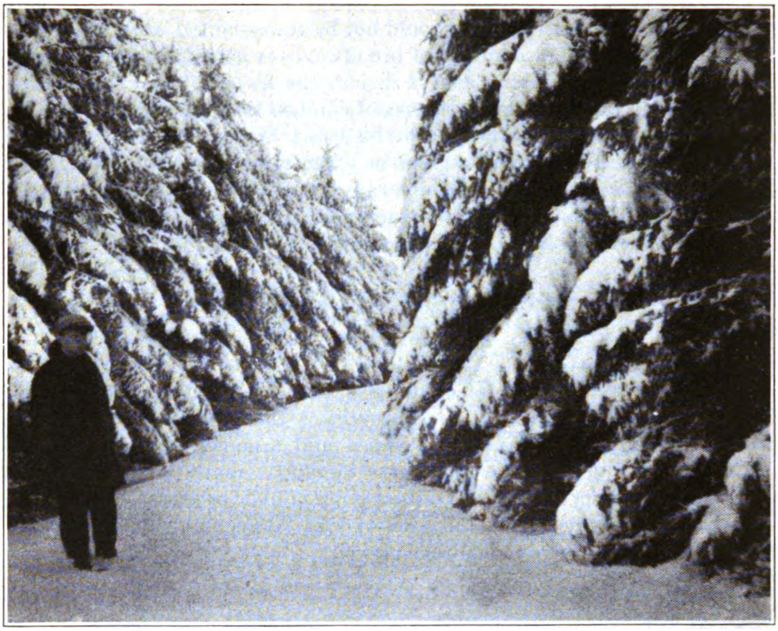
Another guide in the choice of species that are likely to be profitable on a given site is the original forest growth. The species formerly occupying the land can be determined by examination of stumps or by observing the growth on nearby sites that are similar.

Rate of Growth.

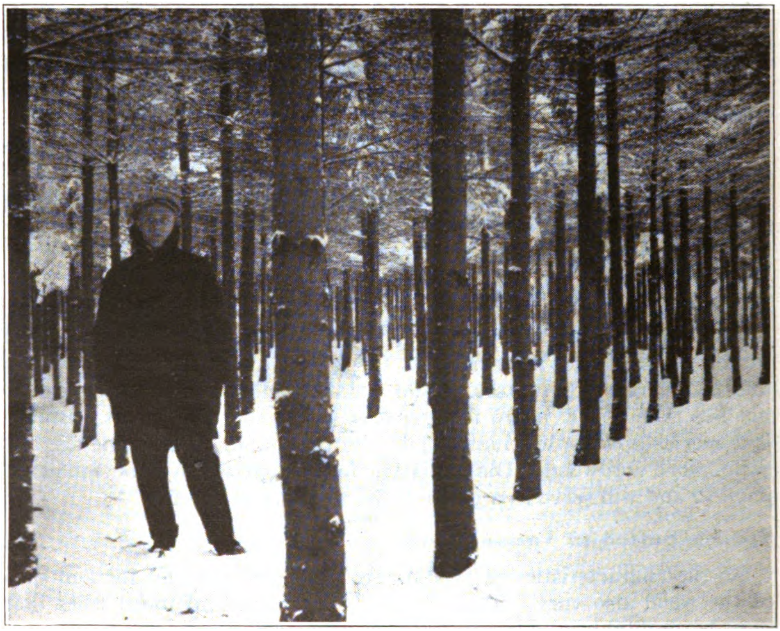
The rate of tree growth is an important factor in selecting species. Species that will grow rapidly and that will produce valuable material in the shortest time are the ones to plant. Under normal conditions and on average sites, pines should produce under proper management not less than 25,000 board feet per acre at the end of 50 years. Broadleaf species produce less lumber per acre than pines of the same age but yield more cordwood. Data relative to tree growth will be found on page 19 and will serve as a guide in the selection of species.

Species Suited to Various Uses.

As the characteristics of tree species vary, the demand for and uses of the wood also vary. Table 1 gives some important forest trees that may be profitably planted in Wisconsin for ordinary uses.



NORWAY SPRUCE PLANTATION—18 YEARS OLD. MILBROOK, N. Y
Courtesy of Forestry Dept., Cornell University.



INTERIOR VIEW OF ABOVE PLANTATION.
Average height 30′. Courtesy, Forestry Dept., Cornell University.

Table 1. Species Suited to Various Uses.

Bolts	Lumber	Pulp	Poles & Posts	Ties
Basswood Butternut Maple Oak Poplar Willow	Larch Pine Spruce Ash Basswood Butternut Maple	Larch Pine Spruce Basswood Poplar Cottonwood	Larch Black locust Red oak	Larch Black locust Red oak

Soil Requirements of Certain Species.

The following table gives a list of some of the more important forest trees and the minimum soil requirements of each; that is, the poorest types of soil on which the given species are likely to be profitable.

Table 2. Soil Requirements of Certain Species.*

Light Sand	Gravel	Sandy Loam	Loam	Heavy Soil
Jack pine Scotch pine Red pine	White pine Red pine Scotch pine	White pine Red pine Norway spruce Red oak White oak Maple Cottonwood	White spruce Norway spruce Larch Butternut Basswood Maple Ash	Hickory Ash Walnut Basswood

*See also pp. 23 to 33 of this bulletin.

Special Considerations.

For extensive planting, conifers are desirable. They are inexpensive to plant, and in addition to their value as timber trees, they are good for windbreaks and are useful for preventing soil erosion. Broadleaf trees are also valuable for preventing erosion, and are suited to many purposes and situations to which conifers are not.

Whether conifers or hardwoods are planted, it is often practicable, when the work is carried on extensively, to plant in mixtures rather than in pure stands. When one species may not be adapted to a given site, another species, if planted with the first, may bring about a condition under which both will reach their best development. Moreover, one species may be subject to attacks by certain fungous diseases or by certain insects, and if planted in pure stands, an attack might damage the whole plantation; but if the species is alternated with another in a plantation, it will be more scattered, and the second species will probably not be subject to attacks of the same kind. Therefore, a plantation with a mixture of species may thrive better than a pure stand.

PLANTING INSTRUCTIONS.

SELECTION OF STOCK.

Conifers.

There is a general idea that large planting stock should be used to produce a good forest. This idea is erroneous, for with large trees the cost of planting is not only multiplied several times, but the percentage of loss is greatly increased. Conifers, on the whole, develop shallow, fibrous roots. A conifer 3 or 4 feet high will have a comparatively small and shallow root system unless it has been transplanted a number of times, and this operation is so expensive that such trees can rarely be used for purposes other than ornamental planting. Furthermore, the tops of conifers cannot be pruned to correspond with the removal of a part of the root system as can the tops of broadleaf species, as pruning a conifer destroys the form desirable in forest trees. In general, it is much the better plan to use stock not more than 12 inches high for plantations of conifers. The trees should be nursery grown, once transplanted, and should be 3 or 4 years old. Nursery grown transplants have compact, fibrous roots, and are much more likely to succeed under adverse conditions than are seedlings, either wild stock or nursery grown trees. To those who are familiar with nursery stock of broadleaf species only, conifers may be disappointing. Until about four years old, conifers grow slowly, averaging less than 6 inches a year. Broadleaf seedlings often grow from 10 to 20 inches a year.

Broadleaves.

With most broadleaf species, one-year seedlings and in some cases two-year old trees are of convenient size for planting. Unlike the conifers, these seedlings have well-developed roots, although they are not usually very fibrous. In the case of the oaks, walnuts, and hickories, which develop long taproots, the roots often need pruning to about two-thirds of their original length, and in planting, holes should be made of sufficient depth to receive them in a natural position. Forests of these species may be started by planting nuts or acorns directly on the site. Forest grown seedlings of broadleaf species can often be secured, and are very likely to succeed in the plantations.

TOOLS.

Before any planting is attempted, adequate equipment should be provided. Pails will be necessary for carrying the trees as they are being planted, and either grub hoes or spades will be needed for making the holes. Sixteen-quart galvanized iron pails are inexpensive, durable and light in weight and will contain as many trees as a planter can easily carry. Spades may be used where the soil is easily worked, but where sod, roots and rocks are encountered, grub hoes or mattocks are much better.

HEELING IN.

When the trees arrive at the planting site, they should be taken from the containers and "heeled in" until ready to be set out. Heeling in consists of plowing or digging a trench or series of adjacent trenches, in which the roots of the trees are placed, and then covered with moist earth, the covering extending up over the lower stems. If the trees are in bundles, the strings should be cut and the trees evenly distributed along the trenches. If a series of trenches is required, the soil taken from one trench can be used to cover the roots of the trees in the trench immediately preceding, thereby saving labor. The trenches should be in a shady place when possible, and should be so dug that the tops of the heeled trees will be inclined slightly toward the south. The trees in heel should not be allowed to dry out. To prevent this, a light covering of boughs or coarse hay is excellent, but the covering should not be so dense that it will cause the trees to mildew.

THE CREW AND ITS ORGANIZATION.

In all the planting operations on state lands, it has been found the best policy to have the crew work in pairs, one man making the holes and the other setting the trees in the ground. In addition to the men engaged in the actual work of planting, a supervisor or foreman is needed for each crew of ten or twelve men. The foreman sees that the lines are kept as straight as possible, and that the men are supplied with trees and water. Usually the foreman needs one or two other men or boys to keep the planters supplied with trees.

SPACING.

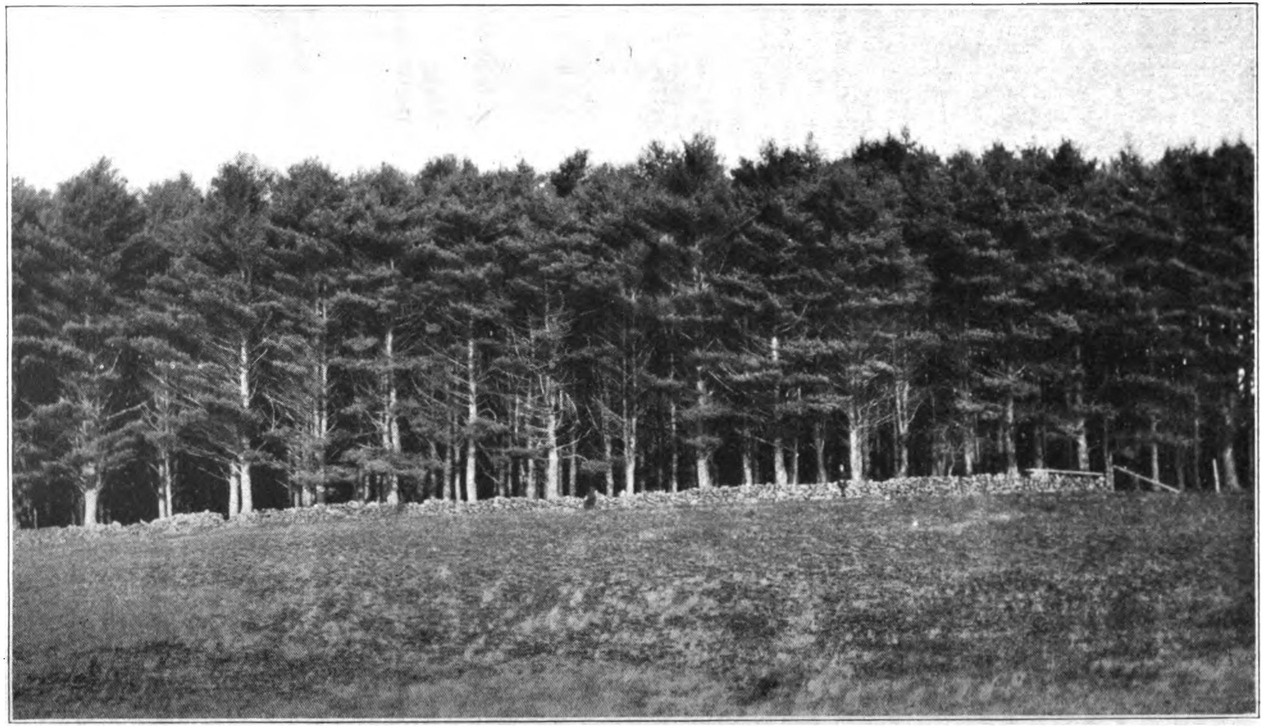
The keeping the rows straight, spacing at the proper distance and watching closely the actual planting, will occupy much of the foreman's time. The rows can best be kept straight by means of two flags, in line, which will guide the man who is taking the lead on the inside row. Each man who is digging holes keeps at the proper distance from the man next to the planted area, and judges the spacing for the holes in his row as he proceeds.

If the nature of the work is such that the rows should be straight and the spacing exact, it will be a great advantage to have several line stakes for each row of trees, and to have stakes or other marks to govern spacing in the rows. In extensive planting, however, it is far more important to have the trees carefully planted than to have them spaced at precisely the same distance. Such careful spacing requires much additional time and expense which is not generally warranted.

Table 3. The number of trees that may be planted on an acre of ground with a given spacing. (Rectangular planting.)

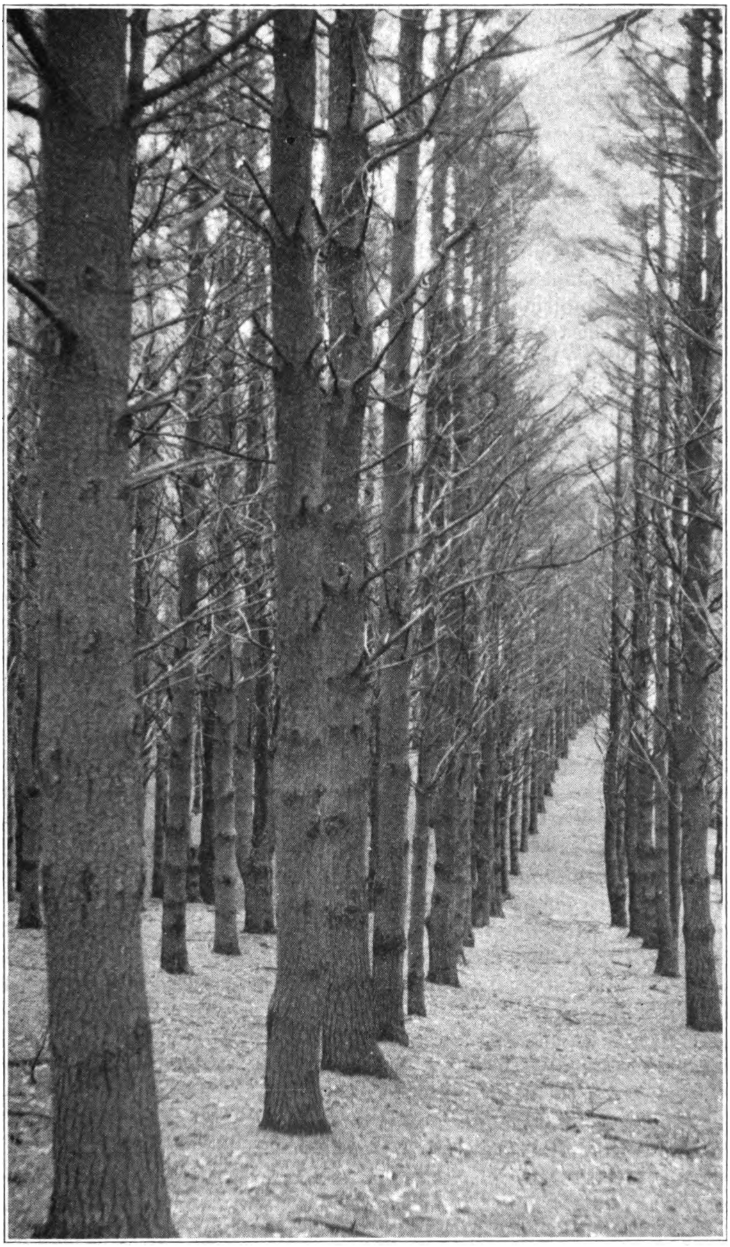
Spacing	No. trees per acre	Spacing	No. trees per acre
3 x 3 feet	4,840	6 x 6 feet	1,210
4 x 4 feet	2,722	7 x 7 feet	889
5 x 5 feet	1,742	8 x 8 feet	680

There are many factors governing the proper distance to space trees in a plantation. Individual requirements will to some extent determine



A 55 YEAR OLD PLANTATION OF WHITE PINE IN MASS.

Average height 50′. Total board feet per acre 43,790. Courtesy of Mass. Forestry Dept.



A VIEW OF THE SAME TRACT, TAKEN INSIDE THE WOOD.

Courtesy Mass. Forestry Dept.

the distance. If species that are tolerant of shade are planted, the spacing may be much closer than if intolerant species are used. Six feet apart each way is considered an economic and suitable spacing for most conifers, for with this spacing the final stand will need very little replanting if conditions are reasonably favorable.

METHODS OF PLANTING.

The actual work of planting a tree is comparatively simple and quickly done. It is, however, very important that great care be taken in doing it. The trees should be carried in pails containing sufficient water to keep the roots moist at all times. Puddling is not recommended.* The men with the implements should make the holes of sufficient size to receive the roots of the trees in a natural position. In making the holes, all sod and litter are scraped away, exposing about a square foot of the mineral soil. The soil is then pulverized, and the loose earth from each hole is left in a small mound close to it, where it can be easily used by the planters. In plantations where the time and additional expense can be permitted, the bottom of each hole should be made to conform to the root system of the various species. With flat-rooted species such as spruce, a small mound may be made in the center of each hole, and the roots spread out evenly upon it, so they will be in their normal position. The soil is then firmed about the roots, and when the hole is filled, the tree should be slightly deeper than when in the nursery, Speed in planting is developed by reducing motions to the minimum and by careful supervision.

It is much better for the trees to spread the roots in the manner described above, but when extensive planting is done, the practicability of such a method except with large stock is questionable. With careful supervision, planters can place the roots of small trees in a natural position by simply holding the trees in the left hand and carefully tamping the soil into the holes with the right. The soil having been replaced in the hole, the planter firms the surface with hands or feet and proceeds to the next hole, where the process is repeated.

Frequently the roots of conifers are of uneven length, and a few of the roots are much longer than the main ones. In such cases it is better to cut the long, straggling roots to about the length of the main roots rather than to twist or misplace them when setting the trees in the ground. When necessary, trimming of the roots can best be accomplished when the trees are in bundles at the nursery or at the time of heeling in. It may be done by placing the roots on a block and cutting the ends of the long ones with a sharp axe or hatchet. Care must be taken not to cut the roots so short as to injure the trees. Unnecessary trimming is to be avoided.

On sites where there is a great deal of sod and where roots and rocks will not interfere with plowing, planting in furrows will be productive of excellent results. Single furrows may be plowed where the rows are to be planted, and the holes for the trees made at the proper distance apart in the furrows. On steep land furrowing should be avoided or the furrows should be run along the contour of the hill, with interruptions by turning back the sod between plants.

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*"Puddling" the roots by dipping them into a puddle of thin mud was formerly thought advantageous, but this practice is now condemned on the ground that it mats the roots together, and does not allow their being planted in a natural position.

In addition to the methods just described, which are modifications of the hole method, there are a number of less desirable methods to be distinguished. Most of these, however, are designed solely to hasten the work of planting with little or no regard for the quality of the work or for its final results. One of these methods is known as the slit method. It consists simply of making a vertical slit in the ground with a spade, suspending the roots of the tree in the slit, and closing the opening with the heel or with the planting tool. This method should never be used except with very small stock, as it crowds the roots into a small space.

When grub hoes are used for planting, the slit method can be modified by driving the blade of the hoe into the ground, giving the handle a slight turn to either the right or the left, and pushing it backward so as to open a hole at the end and edge of the blade. This operation leaves a hole large enough for the roots of most seedlings and small transplants of conifers, and the planter needs only to place the roots in the holes, withdraw the mattock and to press the soil around the roots with the hand or with the heel. The method is not so slow as the hole method, and if the work is done properly, it will be found a very good and inexpensive method of planting small conifers on soils where it can be used.

CARE IN HANDLING TREES.

In planting young trees the greatest care should be exercised to prevent the drying out of the roots, and to plant the trees with the roots at the proper depth and in the proper position. Conifers are especially susceptible to drying out of the roots, but broadleaf species should also be handled very carefully. Trees are more likely to make a very poor growth if the roots are matted, crowded, or otherwise misshapen when planted, and on sites where moisture is less abundant, greater losses may result. Trees so planted may grow well for a number of years and then die for lack of food.

If the roots become dry the trees are almost certain to die during the first year; poor planting will usually result in the death of the trees a few years after setting; but the ultimate result will be the same in each case, namely, a failure.

CARE OF PLANTATIONS.

Forest plantations require very little care during the first few years. If the trees are spaced at 6 feet, no thinning is likely to be required for at least 15 or 20 years. If 60 per cent of the trees planted survive, no filling of blanks will be necessary unless fail places are very large or unless a dense stand is desired.

In old fields the formation of sod menaces the young trees, and this may be checked by removing the sod on a space one foot square where each tree is to be set.

Insects and fungous diseases sometimes attack young forest trees. Both have in some cases been serious, but great damage from either source is comparatively rare. Birds are very effective in the control of insects, and should be given protection at all times. If insects or fungous diseases appear to do any serious damage, it would be well to apply to the state for aid and advice.

PROTECTION FROM FIRE AND GRAZING.

Fire is more destructive to the forest than any other agent. A small fire that would not seriously damage mature timber may kill young growth. It is very necessary that fires be kept out of planted areas, or other land supporting valuable forest growth. A method of fire prevention must be determined for each individual area.

In the protection of an area from fire, it is first necessary to have the area accessible. If it is large, it should have a number of fire lanes or roads traversing it. Fire lanes when properly constructed can be used for roads, at least in cases of emergency. The location of fire lanes and roads will depend upon the size, location and topography of the area to be protected. Roads and fire lanes are useful first, in making an area accessible; second, in providing firebreaks which may stop fires, or at which a crew of men may stop fires, and third, in providing lines from which back fires may be started.

When an area has been made accessible by an adequate number of roads and fire lanes, the protection depends largely upon the care with which the area is guarded in dangerous seasons. A small fire if discovered in time may be easily extinguished, but if neglected for even a short time, may do great damage. It is of the utmost importance that fires be discovered and extinguished before they have gained any headway.

Fires should be attacked from the front when possible. Small fires can usually be extinguished with sand. Sand and water are also very effective in checking larger fires. Large fires usually require backfiring. A backfire which can be easily controlled, may be started from a road or fire lane toward the main fire, when it would be impossible to get near the main fire to attack it, and the main fire will die out when it reaches the belt burned over by the backfire. The greatest care should be exercised after a fire has been apparently extinguished to see that it is not fanned into new activity by a wind.

Forests should be protected not only from fire, but from other destructive agencies. Grazing stock is very destructive to young growth especially in small areas such as farm woodlots. Stock not only browse upon young trees, especially broadleaf deciduous species, but they trample upon and kill or deform them. The best yield can be obtained from the forest when it is not used for pasture.

COST OF PLANTING.

The cost of forest planting is extremely variable. This is especially true when small areas are planted, or when extensive operations are attempted by those unfamiliar with the work. The factors that influence the cost are (1) accessibility of the planting site, (2) the amount and nature of ground cover and litter on the site, (3) the kind of soil, (4) the source and size of the planting stock, (5) method of planting, and (6) the supervision of the planting crew.

Cost per Acre.

The cost of planting on state lands has been from $7 to $10 per acre, including the cost of the trees, planting, and all incidental expenses. It is the intention to keep this cost at not more than $8 per acre on an average, but in some instances it will necessarily be higher. The table below gives the itemized cost of some of the work done on state lands in the spring of 1914. In this work, an average of 1,000 trees was planted to the acre.

Table 4. Cost of Planting per Acre.

Trees	Transportation	Surveying	Planting	Equipment	Supervision	Total per acre	Total area (acres)
$2.50	$.01	$.18	$2.66	$.07	$.32	$5.74	10
3.00	.02	.12	3.19	.08	.38	6.79	40
4.00	.01	.18	2.66	.07	.38	7.30	10
2.50	.29	.17	2.08	.13	.09	5.26	35
2.00	.35	.22	3.11	.11	.05	6.84	20

The cost of planting in a number of other states varies from $6 to $15 per acre, with an average of perhaps $10. In Wisconsin, the average cost, including all expenses, is somewhat less than this average, or about $8 per acre. The cost of private planting varies between $8 and $10 per acre, if the site is favorable, if the stock can be bought at a reasonable price, and if competent men can be secured to superintend the work.

Financial Returns.

Whether forest planting should be undertaken depends largely upon the financial returns that may be reasonably expected. As forest planting was so recently begun in Wisconsin, no cost figures are at present available. Assuming that this cost does not vary appreciably from the cost in other states, planting in Wisconsin will net fair returns.

The following table shows the cost of raising white pine in New England and gives the value of the pine at different ages:

Table 5. White Pine in New England*—Per Acre.

Age yrs.	Land and Planting[1]	Administration and Protection[2]	Taxes	Total Cost	Size in.	Yield M. ft.	Cost per M.[3]	Stumpage value per M.
40	$45.01	$4.75	$9.50	$59.26	6.7	20	$2.96	$5.00
50	68.07	7.63	26.43	102.13	9.0	30	3.40	6.00
60	102.20	11.90	61.09	175.19	10.7	38	4.61	7.00
70	152.72	18.21	122.71	293.64	12.0	45	6.53	8.00
80	227.50	27.56	225.19	480.25	12.9	50	9.61	9.00
90	338.19	41.40	387.67	767.26	14.5	55	13.95	10.00

[1] Land and planting, $10.00 per acre.
[2] Administration and protection, 5c per acre.
[3] Interest compounded annually at 4 per cent.
*The Cost of Growing Timber, R. S. Kellogg and E. A. Ziegler, American Lumberman, Chicago, 1911.

Table 5 shows the profit that may be expected from white pine plantations under reasonably favorable conditions. In most plantations on which reports have been made, the maximum profit may be realized when the plantations are 50 years old. A net profit of 6 per cent interest, compounded annually, is common.

PLANTING VS. DIRECT SEEDING.

Since reforestation began on state land in 1911, numerous inquiries have been received as to why it is better to sow the seed in the nursery, to incur the expense of caring for the nursery stock for 3 or 4 years, and then to add the expense of planting the trees, than it is to sow the seed on the area to be reforested. At first thought the nursery might seem to be a very expensive and unnecessary step in the growing of forest trees.

Direct seeding may be productive of good results if conditions are exceptionablly favorable but ordinarily the method is expensive and impracticable. In direct seeding, whether by broadcast sowing or by the seed-spot method, no less than 5 pounds of coniferous seed is required for an acre of ground. The initial cost of the seed would therefore be not less than $8 or $10. Adding to this amount the necessary expense of preparing the ground, sowing the seed, and subsequently dragging or harrowing, the total cost per acre would be about $15, which is almost twice the cost of planting with first-class nursery stock.

Not only is the cost of direct seeding excessive, but the results are usually very poor. Birds and rodents eat large quantities of the seed, and a few days of hot, dry weather when the remainder of the good seed is germinating, is sufficient to kill almost all of the tender, unprotected seedlings. In the nursery the seed and seedlings are properly cared for, and a pound of good coniferous seed will produce from 10,000 to 25,000 seedlings, according to the species.

Broadleaf species that bear seed of good germinating quality can often be successfully grown by planting the seed in the field. The seed-spot method is recommended in such cases. The soil in plots of about one foot square is pulverized, and the seed is placed in the pulverized soil at the proper depth. The oaks and other nut-bearing species usually, with this method of planting, give the best results, but whatever species are used, the seed should be of good germinating quality and the locality should be comparatively free from rodents that are likely to destroy the seed. Only a few seeds are required for one seed spot, and the seed spots may be spaced at whatever distance the owner of the land prefers; but ordinarily the spacing is from 6 to 8 feet each way.

It is a fact that many areas reseed naturally, but where an area has been burned over repeatedly, there is little or none of the natural reproduction left. Therefore, if such areas are to be made productive of good forest growth, artificial regeneration must be practiced.

RATE OF TREE GROWTH.

Different species vary greatly in the rate of growth, and trees of the same species will vary greatly in the rate of growth on different sites.

Table 6. Rate of Growth of Forest Trees.

Very Rapid	Rapid	Moderate	Slow
Black locust	Scotch pine	Jack pine	Cedar
Poplar	White pine	Red pine	Red spruce
Cottonwood	Basswood	Scotch pine	Hickory
Willow	Elm	Norway spruce	Maple
		Larch	Pin oak
		Ash	White oak
		Butternut	
		Elm	
		Red oak	

Table 7. Diameter and Height Growth.*

Species	Age 30 years.		Age 50 years.		Age 80 years.		Age 100 years.	
	Diam. in.	Height ft.	Diam. in.	Height ft.	Diam. in.	Height ft.	Diam. in.	Height ft.
White pine[1]	5.8	42	10.6	60	16.6	82	20	92
Red pine[1]	5.8	45	10.3	75	15.3	90	17.6	95
European larch[2]	8.8	45						
Red oak[3]	7.6	56	12.4	76	16.4	86		
White ash[4]	7.8	67	12.1	90	17.5	103	20.3	106

[1] Data obtained in northern forests.
[2] Farm plantations in Illinois; figures would be lower for forest grown trees.
[3] Data secured in Central Hardwood region; figures would be somewhat lower in the northern states.
[4] Data from the southern forests; figures would be somewhat lower in the northern states.
*Compiled from The Woodsman's Handbook, Bulletin 36, U. S. Forest Service.

The Yield of Some Plantations.

The following figures give the yield of some plantations in New York state growing on non-agricultural lands:

1. *White pine (small per cent other species)..........44 years old, 38,000 ft. B. M.
2. *Norway spruce and Scotch pine..........40 years old, 26,000 ft. B. M.
3. *Scotch pine..........35 years old, 27,000 ft. B. M.
4. †White pine..........31 years old, 18,500 ft. B. M.
5. *White pine..........28 years old, 24,000 ft. B. M.
6. †Scotch pine and European larch..........25 years old, 13,000 ft. B. M.
7. †Norway spruce..........22 years old, 10,000 ft. B. M.

*First quality site.
†Third quality site.

PRIVATE PLANTING IN THE STATE.

COÖPERATION OF STATE.

It is the policy of the Conservation Commission to encourage private forest planting throughout the state, and to render assistance to landowners who engage in the work. This aid to planters is of four kinds: first, the sale of planting stock from the state nurseries at a reasonable figure; second, the giving of advice and aid by correspondence; third, the examination of tracts and making of planting plans by competent foresters at actual cost to the state; fourth, the superintending of planting operations by foresters at actual cost to the state.

A 39 YEAR OLD PLANTATION OF WHITE PINE.

Bridgewater, Mass. Courtesy Mass. Forestry Dept.

Planting Stock from State Nurseries.

Each year, the state forest nurseries furnish a considerable amount of planting stock for private planting. This stock is grown in the northern part of the state from carefully selected seed, and hence is very hardy, although somewhat smaller than trees of the same age grown in warmer climates where there is a longer growing season.

Following is a price list of trees that may be secured from the state nurseries. It is not always possible to furnish all the stock listed, and sometimes stock is available that is not listed here.

Table 8. Prices of Nursery Stock, F. O. B. Nursery.

Species[1]	Age Class[2]	Price per 1,000[3]
White pine	2-yr. seedlings	$1.50
	3-yr. transplants	3.50
	4-yr. transplants	4.00
Red pine	2-yr. seedlings	1.50
	3-yr. transplants	3.50
Scotch pine	2-yr. seedlings	1.50
	3-yr. transplants	3.50
White spruce	3-yr. transplants	3.50
	4-yr. transplants	4.00
Norway spruce	3-yr. transplants	3.50
	4-yr. transplants	4.00
White ash	2-yr. seedlings	1.50
Basswood	1-yr. seedlings	3.00
Red oak	2-yr. seedlings	2.00

[1] Additional lists and application blanks may be secured from the State Conservation commission upon request.

[2] Three year transplants of conifers are trees that have been in seed beds two years and in the transplant beds one year, making a total of three years.

[3] No orders filled for less than 100 trees of any one species. On orders of less than 1,000 trees, the price is computed at the regular rate plus 50c extra for packing.

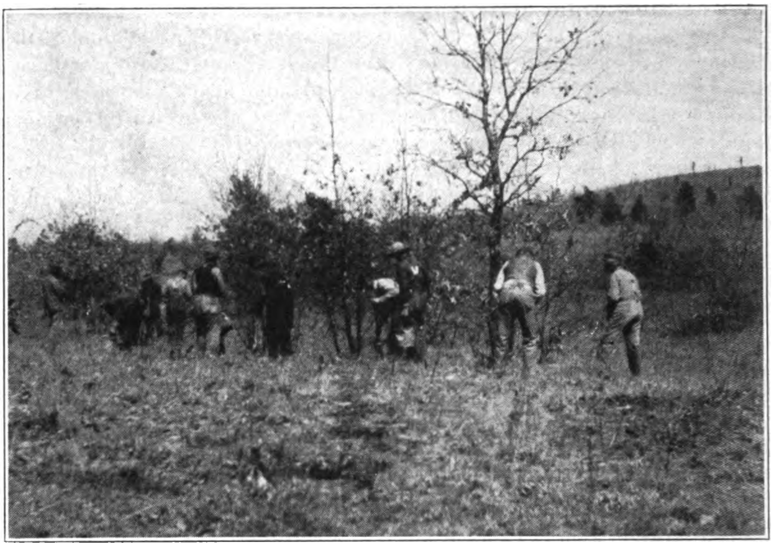
NOTE. The state nurseries do not come into competition with commercial nurseries. No stock is sold for ornamental planting and no large sized stock is sold. The cost of starting forest plantations with the stock ordinarily put out by commercial nurseries would be prohibitive. Therefore, the state, in view of the public benefits to be secured by forest planting, has made planting stock available for use within the state, at a low price.

Giving of Advice and Help by Correspondence.

If a landowner desires advice and help in connection with a prospective planting operation, he should address a request to the State Conservation commission, giving full information in regard to the land to be planted and the particular purpose for which it is to be planted. Such advice and help as it is possible to give him without putting him to the expense of examining his land, will be given by correspondence.

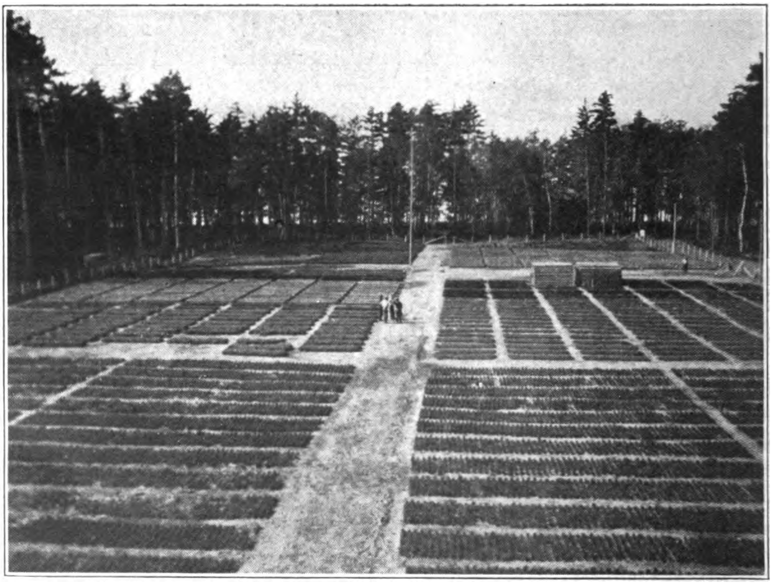
Examination of Areas by Foresters.

When a planting operation of sufficient importance to warrant the expense is to be undertaken, the state will send a forester to look over the tract and make a planting plan and estimate of cost, at the expense of the owner and at cost to the state. If applications for the examination of tracts can be listed early, so that a forester can visit several on a single



PLANTING CREW AT WORK ON CUT-OVER LANDS.

The cost of planting is about $8.00 per acre on land of this type.



A PORTION OF THE STATE FOREST NURSERY AT TROUT LAKE.

Transplant beds in the foreground; seed beds in the background. The total area of this nursery is 7 acres. Annual capacity 1,000,000 trees.

trip, the expense will be considerably reduced. Before an examination is applied for, the landowner should send detailed description of his tract and all possible information.

Supervision of Planting.

When planting is done on an extensive scale, it is often possible to have a forester superintend the work, or superintend the beginning of it at least. In this case, as in the examination of tracts for planting, the owner incurs the expense of the forester's services.

PRIVATE PLANTATIONS STARTED.

The interest in forest planting has increased yearly, since the state adopted the policy of encouraging tree planting. The following figures give the number of plants set out on private lands by years:

1914—20,200
1915—77,400
1916—Applications had been listed up to Feb. 1, for about 250,000.

The following organizations and individuals have taken advantage of the opportunities offered by the state and have planted trees on their lands:

Name	1914 *Address*	*No. of trees planted*
W. H. Bradley	Minocqua, Wis.	500
P. N. Burg	Shell Lake, Wis.	400
I. G. Crowell	Shell Lake, Wis.	1,000
Delta Land Co.	Trempealeau, Wis.	10,000
Florence Iron Co.	Florence, Wis.	6,000
R. J. Nye	Superior, Wis.	1,000
Washington County Asylum	West Bend, Wis.	1,300
		20,200

	1915	
Mrs. Max Adler	Minocqua, Wis.	500
V. P. Atwell	Stevens Point, Wis.	3,200
O. C. Doering	*Chicago, Ill.	3,000
Jerry Donohue	Sheboygan, Wis.	14,000
Florence Iron Co.	Florence, Wis.	3,000
R. C. Heinz	*Leavenworth, Kan.	400
Jos. Kemp	Woodford, Wis.	1,000
R. J. Nye	Superior, Wis.	3,000
Percy Ap Roberts	River Falls, Wis.	300
C. A. Tilt	Woodruff, Wis.	200
E. M. Weaver	Woodruff, Wis.	250
W. R. Wilmont	Sayner, Wis.	500
Everett Wilson	*Winnetka, Ill.	48,000
		77,450

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*These trees were planted in northern Wisconsin.

SILVICAL NOTES ON SOME IMPORTANT SPECIES.*

WHITE PINE (*Pinus strobus*).

White pine is widely distributed throughout the northeastern United States, and is the largest and most valuable of the eastern conifers. It is more or less abundant over the entire state of Wisconsin.

White pine prefers fresh, well-drained sites, although it is not very exacting in its requirements. It does not succeed well, however, on dry and exposed situations. It is moderately tolerant of shade until 40 or 50 years old, when it becomes rather intolerant. It is an excellent tree for planting in most parts of the state, and grows rapidly, either in mixture or in pure stands.

It grows to a merchantable size, that is, a size that can be cut profitably, in 50 to 75 years, when it may be expected to produce from 30,000 to 40,000 board feet per acre.

For planting, 3 or 4-year transplants should be used, and should be spaced 6 by 6 feet.

RED OR NORWAY PINE (*Pinus resinosa*).

Red pine is common in the northeastern United States, although it reaches its best development in northern Michigan, Wisconsin and Minnesota.

It grows best on well-drained, sandy loam soil, but it also thrives on poor sands. It grows rapidly and suffers little from fire, insects or disease. It is intolerant of shade at all ages, and therefore should be planted in pure stands or with slower growing species. It may be successfully planted in all parts of the state, especially on the northern pinery lands. 3-year transplants are the best size for planting, and should be spaced 6 by 6 feet. Red pine develops strong lateral roots, and is very windfirm when planted on exposed sites.

JACK PINE (*Pinus divaricata*).

Jack pine is found principally on sterile, sandy soils. It grows rapidly until 25 or 30 years old, but never becomes a large tree. It reproduces well, especially after fires, as the cones containing the seed remain on the trees for years, often until opened by the heat from fires.

Of this species, 2-year seedlings or 3-year transplants may be planted, but on account of the inferiority of the timber, planting is rarely advisable when red or Scotch pine can be planted. The latter species grow well on poor sites, and are much more valuable when mature than jack pine.

SCOTCH PINE .(*Pinus sylvestris*).

Scotch pine is native over a large part of Europe, and is being planted extensively in this country. As a timber tree, it is very similar to our native red pine but is somewhat inferior in quality, although much better than jack pine. Thus far it has not become of commercial importance in this country.

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*Forest planting leaflets for various species can be obtained usually from the Forest Service, Washington, D. C., and can be purchased from the Superintendent of Documents, Washington, D. C., for 5 cents each.

Scotch pine grows well on sterile, sandy soils, and being very hardy, it is a good species to plant on exposed situations. It is very intolerant of shade, but grows rapidly when exposed to sunlight. Seedlings 2 years old or transplants 3 years old should be planted with a spacing of 6 by 6 feet. Scotch pine attains a merchantable size in from 40 to 50 years.

TAMARACK (*Larix laricina*).

Tamarack is the only deciduous conifer native to Wisconsin. It has a wide range, including practically all of the state. It commonly grows along the borders of swamps and the banks of streams, but reaches its best development on moist uplands. It is not recommended for extensive planting because of the inferior quality of the wood as compared with many other species, the small size of mature trees, and the attacks that are sometimes made upon it by the sawfly.

It grows rather rapidly, but being very intolerant of shade it does not do well except in the open. It reaches a height of about 70 feet.

EUROPEAN LARCH (*Larix europaea*).

European larch is very similar to our native tamarack. Unlike the tamarack, larch does not grow in swamps, but prefers a well drained but reasonably moist site. It is very intolerant of shade, but as it grows rapidly it can be planted in mixture with species that it will outstrip. It grows best on northern slopes, where in its native soil it often reaches a height of 100 feet.

The wood is resinous, and is excellent for ties, posts, and poles. It is also used in boat building.

For planting, either 2-year seedlings or transplants of the same age are recommended. Like the tamarack, the larch is deciduous, and should be planted early before the leaves begin to grow or in the fall.

BLACK SPRUCE (*Picea mariana*).

Black spruce is a small tree, typical of sphagnum swamps in Canada and the northern United States. It is an extremely slow growing tree, especially on the uplands, and is not recommended for planting. This species is sought after for pulp and for Christmas trees.

RED SPRUCE (*Picea rubens*).

Red spruce is found in the northeastern United States, but its natural range does not extend as far west as Wisconsin. In many respects it is similar to black spruce, but instead of growing in swamps, it grows on moist hillsides, where it forms very dense stands. It grows slowly, which makes it an undesirable tree for any but ornamental planting.

WHITE SPRUCE (*Picea canadensis*).

White spruce is native to Wisconsin and grows on the better classes of soils. It grows on moist uplands, rarely if ever being found in the swamps. It is the common upland spruce of the lake states.

ROAD AND FIRE LANE MADE ON AN OLD LOGGING RAILROAD GRADE.

Fire protection is all that is necessary in many places to bring back the forest on cut-over land.

It grows reasonably fast and while it has not become of great importance in reforestation, there is every reason to believe that it will rival the Norway spruce in growth and quality of lumber, if planted on favorable sites. The 3 or 4-year transplants should be used for planting, and as the tree is very tolerant of shade, it may be spaced 5 by 5 feet, if desired.

NORWAY SPRUCE (*Picea excelsa*).

Norway spruce is native to Europe where it is greatly in demand for pulp and lumber. It is a more rapid growing tree than our native species and in many ways superior to them. It prefers moist, well-drained sites, and although not exacting with regard to soil, it grows best on reasonably fertile soils.

Norway spruce is tolerant of shade and grows well in pure stands or when planted in mixture with white pine, red pine or hardwoods. It is fast becoming an important tree for reforestation in this country, as it produces excellent pulpwood in from 30 to 40 years. It is also valuable as a substitute for white pine.

The young plants are susceptible to scorching by the sun when planted on south slopes where there is no protection. On sites of this type, fall planting is recommended, for if planted in the fall the trees can become well established before the hot weather of the following spring. It is the safest plan, however, to plant spruces where there is enough ground cover to protect them until they become established in the soil.

There are two objections to Norway spruce. One is that in the United States it seems to be short-lived, lasting only about 50 years, This does not decrease its value for pulp, as it produces an excellent crop in from 30 to 40 years, The other objection is that it does not reproduce well. Although it produces large quantities of seed, it is a rare occurrence to find seedlings in the neighborhood of old trees; hence stands must be formed artificially. For planting, 3 or 4-year transplants should be used.

HEMLOCK (*Tsuga canadensis*).

Hemlock is not common in Wisconsin, except in the northeastern part of the state. It is a slow growing tree and produces lumber of inferior quality, which until recent years was thought to be of little commercial importance. The bark is valuable in the manufacture of tanning extract.

Hemlock is very tolerant of shade, and grows in dense stands on moist uplands where the soil is of reasonably good quality. It is usually found mixed with hardwoods. Because of its slow growth and inferior quality, it is of little value for commercial planting.

BALSAM FIR (*Abies balsamea*).

In Wisconsin the balsam fir is a short-lived tree of small size and very inferior quality. It reaches its largest size in Maine, where it is of considerable importance. It does not thrive on sandy or acid soils, but prefers a moderately moist, deep loam.

Balsam is not recommended for planting in Wisconsin except for ornamental purposes. In large stands it dies, falls over and makes a very dangerous firetrap, the limbs often forming an almost impenetrable tangle.

WHITE CEDAR OR ARBOR VITAE (*Thuya occidentalis*).

White cedar is a common tree in Wisconsin. It is usually found in swamps and on moist sites where it forms dense stands. It is used for many purposes including posts, poles, ties and shingles.

The slow growth of the white cedar makes it a poor tree for commercial planting. It is a beautiful tree for ornamental planting and is particularly desirable for hedges as it can be trimmed to any form desired.

RED CEDAR OR JUNIPER (*Juniperus virginiana*).

Red cedar is widely distributed throughout the eastern half of the United States. It grows on the uplands, often in very dry situations, although it reaches its best development on alluvial plains.

As it grows slowly, and is the alternate host for a rust that seriously affects nearby apple trees, it is a poor tree for either commercial or ornamental planting.

BUTTERNUT (*Juglans cinerea*).

Butternut is found in much of the Central Hardwood Forest region* including central and southern Wisconsin. It prefers good soil, moist but well-drained, and while quite hardy is most frequently found in protected locations:

The wood is used for furniture, boxes, woodenware, interior and exterior finish, and for many other purposes.

The butternut is a good tree for planting on good soil. It grows rapidly, and is desirable for shade trees and for timber. It is intolerant of shade and should be planted 8 or 10 feet apart each way. It may be raised from seed or purchased from nurseries, the latter method being recommended. 1 or 2-year seedlings are a convenient size for planting.

BLACK WALNUT (*Juglans nigra*).

Black walnut is not of commercial importance in Wisconsin. While closely related to the butternut, it is less hardy and consequently does not have so great a range.

The walnut is very valuable and is used chiefly in the manufacture of furniture, in cabinetwork and for gun stocks.

Walnut prefers rich bottom lands, and grows best in protected locations. It is not recommended for extensive planting in Wisconsin, although it may prove successful in the southern part of the state. 1 or 2-year seedlings are the best size for planting.

BITTERNUT (*Carya minima*).

Bitternut is a native of central and southern Wisconsin, and has a wide range throughout the Central Hardwood Forest belt. It is a beautiful tree for ornamental planting but is of very little commercial importance in Wisconsin. It prefers a moderately good soil, and grows rather rapidly.

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*Map of Forest Regions of The United States; Bulletin 61, U. S. Department of Agriculture, Forest Service.

SHELLBARK HICKORY, SHAGBARK (*Carya ovata*).

Like the bitternut, the shellbark hickory is a native of central and southern Wisconsin. It prefers rich, moist sites. It grows slowly, and is not desirable for any but ornamental or shade tree planting.

The shellbark hickory has many uses, and is especially valuable for implement and vehicle stock. The nuts are of commercial value.

COTTONWOOD (*Populus deltoides*).

Cottonwood is widely distributed throughout the central and eastern United States. It is typical of moist sites, particularly along the borders of streams where the soil is of a fair quality.

Cottonwood is used for fuel, lumber and vehicle stock, and is now being used extensively for pulp. It is planted for shade, for windbreaks and for timber. It grows very rapidly, but does not clean well of branches, often sending out large branches 16 or 20 feet from the ground.

It is often grown from cuttings, although seedlings can be purchased from nurseries. It should not be planted near wells and sewers as the roots run toward water for long distances and frequently form large masses in them.

This species is known also as the Carolina poplar. It is not uncommon for it to make a growth of from 3 to 5 feet per year.

WHITE BIRCH (*Betula papyrifera*).

White birch is a very common tree in Wisconsin but is found principally in the northern half of the state. It is of little commercial value in Wisconsin because of its small size and the fact that it is seldom free from red-heart. The wood makes excellent fuel if split soon after cutting but if not split the close grained bark causes the wood to sour, greatly reducing its value for fuel.

White birch is a good tree for ornamental planting. The cutleaf variety sold by commercial nurseries is perhaps superior to our native birch for this purpose and can be purchased at a reasonable price.

YELLOW BIRCH (*Betula lutea*).

Commercially, yellow birch is far superior to white birch. Yellow birch grows on moist uplands where the soil is of good quality and it is usually found in mixture with other hardwoods and with hemlock.

The wood is heavy, hard and strong and adapted to a great variety of uses.

Yellow birch requires a low temperature, and is not recommended for planting. It has never been planted for commercial purposes in this country.

BEECH (*Fagus atropunicea*).

The beech has a wide range and is found on the better soils in the eastern part of Wisconsin. It is a beautiful forest tree and is easily

PLANTATION OF SCOTCH PINE AT TROUT LAKE, VILAS CO., WIS.

Age 7 years. Average height 5′. Over 90% of number planted are thriving.

grown from seed. Because of its slow growth and the comparatively low value of the wood, it should not be planted except for ornament. It is an excellent tree for planting in parks.

RED OAK (*Quercus rubra*).

Red oak is found over most of the eastern half of the United States, including all of Wisconsin. It is found principally on sandy soils and is very common on ridges and hillsides. It is a hardy tree and grows rapidly. It also sprouts vigorously from the stump. It is used for many purposes including ties, implements, furniture and veneer.

Many successful plantations of red oak have been made in the eastern states. Plantations may be made with seedlings or by planting acorns, although the former method is more certain of success.

Plantations need very little care. Seedlings may be planted from 6 to 10 feet apart, depending on the desired stand. 2-year seedlings are a convenient size for planting. Red oak is only moderately tolerant of shade and therefore should be planted where it can receive plenty of sunlight. However, close spacing is desirable in order to get good form.

WHITE OAK (*Quercus alba*).

White oak is the most valuable of the American oaks. It is found on a variety of sites but prefers moist, sandy loam soils and warm situations. It grows to large size, sometimes reaching a diameter of 8 feet but is comparatively small in Wisconsin.

White oak has many uses. It is of especial importance in the manufacture of tight cooperage and in furniture making and cabinetwork.

Unlike the red oak, the white oak grows very slowly but it is a persistent grower and reaches a great age. Because of its slow growth it is rarely used in extensive planting.

BUR OAK (*Quercus macrocarpa*).

Bur oak is closely related to white oak. It is more hardy than the latter species and is found on less favorable sites, although in many localities the two are found in mixed stands. Both species grow slowly but the white oak is usually the larger of the two when mature.

The wood of the two species is very similar and little or no distinction is made in the market.

Bur oak thrives on a variety of soils but prefers soil of good quality. It resists drouth well and is a good tree for prairie planting, where its comparatively slow growth is not so objectionable.

WHITE OR AMERICAN ELM (*Ulmus americana*).

White elm is distributed over practically all that portion of the United States east of the Rockies. It prefers good soil and grows on both moist and dry sites. It does not grow in pure stands, but occurs sparingly in mixture with other hardwoods. It reaches a height of 100 feet and a diameter of from 3 to 6 feet.

The wood is very heavy, hard, strong and tough. It is used in the manufacture of implements, wagon and buggy wheels, flour barrels, cheese boxes, cooperage, flooring and for many other purposes where a tough, strong wood is desired.

White elm is a good tree for planting on small areas or in mixture with other hardwoods. It is one of the best species for street and park planting. It is also a hardy tree for prairie planting. It grows rapidly, and often makes a straggling growth but this may be remedied by careful pruning. For extensive planting 1 or 2-year seedlings may be used; but for ornamental purposes, trees several feet in height are preferable.

SYCAMORE (*Platanus occidentalis*).

The sycamore is a common tree in the Central Hardwood Forest belt. It grows on rich bottom lands and along the borders of streams. It is the largest broadleaf tree in the United States, a specimen having recently been found near Worthington, Indiana, that is 150 feet in height with a circumference of 42 feet and 3 inches.

The wood is heavy, hard and close-grained and is used for many purposes, including the manufacture of tobacco boxes, yokes, butchers' blocks, furniture and interior finish.

The sycamore is planted largely as an ornamental tree, not for forest, and grows rapidly on favorable sites. One serious objection to it is the fact that it sheds its leaves early, usually during the month of August. For street planting it is a desirable species, as it is little affected by smoke, dust and gases. It is also very free from insect attack. Trees of any size up to 10 feet may be planted, and may be purchased at a reasonable price.

SILVER MAPLE (*Acer saccharinum*).

Silver maple has a wide range, including a large part of the central United States. It prefers a loose, moist soil but thrives on a variety of sites.

It is of little value as a timber tree and is planted chiefly where a rapid growing shade tree is desired. It is also a good shelter-belt tree. The wood is used for fuel. The wood is brittle and is so liable to damage by wind that it is a poor tree for planting on exposed sites. It is often the best policy to plant it in mixture with other species.

SUGAR MAPLE (*Acer saccharum*).

The sugar maple is the most valuable of all the maples. It is a very valuable tree for lumber and also for the sugar that is made from the sap.

The range of the sugar maple includes practically all of the eastern half of the United States. It reaches its best development on cool northerly slopes of hills, and in favorable situations is often very abundant, growing in dense stands.

Sugar maple is exacting in its soil requirements. It needs a deep, moist soil of moderate fertility for good development. On dry sites or on the poorer types of soil, its growth is very irregular and slow.

The wood is in almost universal demand and is used in 50 of the 55 wood-using industries of the United States. It is an excellent wood wherever a heavy, hard, strong and durable wood is desired.

On favorable situations the sugar maple grows rapidly and persistently. It is one of the most beautiful of all the trees, and is in great demand for street and park planting where smoke and gases, to which it is susceptible, are not likely to injure it. When grown in the open, it branches about 10 feet from the ground and forms a round, compact crown. In dense forest it has a long, clean bole and a small crown. It is very tolerant of shade, and succeeds best when planted where it receives some protection from the sunlight.

BASSWOOD (*Tilia americana*).

Although most common in the Great Lakes region, the basswood is found over most of the eastern United States. It attains its greatest size along the Ohio river, where it commonly reaches a height of 80 feet and a diameter of 2 feet.

The basswood prefers rich river bottom soils and cool situations, and should not be planted on poor soil or where it is likely to suffer from drought. It is rather tolerant of shade, and as the seedlings are easily injured by the hot sun, it should be planted where there is a certain amount of shade.

The wood is soft, straight-grained and easily worked. It is used for many purposes, including woodenware, carriage bodies, trunks, excelsior and paper pulp.

Basswood grows rapidly, and is an excellent tree for planting on good sites. It may be planted in pure stands, or in mixture with white pine or hardwoods. One year seedlings may be used, and may be spaced about 6 by 6 feet.

WHITE ASH (*Fraxinus americana*).

White ash is one of the most widely distributed and one of the most important hardwoods of North America. Its range is from New Brunswick west to Minnesota, south to eastern Texas, and east to the Atlantic coast. It prefers the rich, moist sites throughout its range and attains its largest size in the lower Ohio valley, where it commonly reaches a height of 80 feet and a diameter of from 2 to 3 feet.

The wood is very valuable and is in great demand where a wood of tough and elastic qualities is desired. It is of first rank for furniture, car, and vehicle construction, interior finish, agricultural implements and tools.

White ash is a good tree for both forest and ornamental planting. On good soils it grows rapidly, but on poor soils or in dry situations it grows rather slowly. When grown in the forest it develops a long clean bole, but in the open it branches 8 or 10 feet from the ground and develops a spreading crown. When young it is tolerant of shade, but the older trees require considerable light. It is an excellent tree for mixing with white pine and other species in forest plantations.

GREEN ASH (*Fraxinus lanceolata*).

Green ash is very similar to white ash in many respects. It has a greater range, however, and is found over the greater part of the United States east of the Rockies. Like the white ash, it prefers low, moist ground, but unlike the related species, it is not exacting with regard to soil and moisture. It grows well on dry sites and alkali soils but much more slowly.

The wood is very similar to that of white ash and, although said to be inferior in quality, there is rarely any discrimination between the two species in the market.

Neither white nor green ash reproduce well from seed, and planting stock should therefore be nursery grown. 1-year seedlings are from 6 to 12 inches high, and are of a good age for forest planting.

Pamphlets. Wisconsin.	364043	SD144 W5P3 v.3
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